

**Division of Measurement Standards  
Field Reference Manual  
Revision Index**

<b>2008</b>	
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# **CHAPTER 1.**

## **TOLERANCES AND SPECIFICATIONS FOR COMMERCIAL WEIGHING AND MEASURING DEVICES**

### **Article 1. National Uniformity, Exceptions and Additions**

**4000. – Application.** See Barclays for actual Text

NOTE: This section incorporates the adoption, by reference, of the National Institute of Standards and Technology Handbook 44.

**4001. – Exceptions.** See Barclays for actual Text

NOTE: The following sections of Handbook 44 are not adopted and are annotated “Not Adopted” in the text:

#### **1.10. General Code.**

**G-S.1.2. Remanufactured Devices and Remanufactured Main Elements.**

**G.T.1. Acceptance Tolerances.**

- (b)
- (c)
- (d)

#### **2.20. Scales.**

S.1.8.3. Customer Indications.

N.3. Minimum Test Weights and Test Loads\*.

UR.2.6.1. Vehicle Scales.

UR.3.7. Minimum Load on a Vehicle Scale.

#### **3.30. Liquid Measuring Devices.**

N.4.1.1. Wholesale Devices Equipped With Automatic Temperature Compensating Systems.

#### **3.31. Vehicle-Tank Meters.**

UR.2.2. Ticket Printer; Customer Ticket.

#### **3.32. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices.**

S.2.6. Automatic Temperature Compensation.

N.4.1.1. Automatic Temperature Compensation.

UR.2.3. Vapor Return Line.

#### **3.33. Hydrocarbon Gas Vapor - Measuring Devices.**

S.4.3. Temperature Compensation.

## **Appendix D. Definitions for:**

Remanufactured Devices.

Remanufactured Element.

Repaired Devices.

Repaired Element.

### **4002. – Additional Requirements.** See Barclays for actual Text

NOTE: These requirements are different than, or in addition to, the requirements of Handbook 44 and are included in the appropriate section of the text. They are shaded, bordered, and numbered in the 4002 series to differentiate them from the Handbook 44 requirements.

#### **4002.1. General Code (1.10.)**

- (a) Type Approval Use.

#### **4002.2. Scales (2.20.)**

- (a) Recommended Minimum Test Weights and Test Loads.
- (b) Minimum Load on a Vehicle Scale.
- (c) Class III, Class III L and Unmarked Devices Used for Recycling.
- (d) Livestock Scales Not Equipped with Balance Indicator.
- (e) Customer Indications.

#### **4002.3. Vehicle-Tank Meters. (3.31.)**

- UR.2.2. Ticket Printer; Customer Ticket.

#### **4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices (3.32.)**

- (a) Temperature Compensation.
- (b) Non-applicability of Handbook 44 under certain conditions.
- (c) Wholesale Devices Equipped With Automatic Temperature Compensating Systems.
- (d) Vapor Return Line.
- (e) Signs.

#### **4002.5. Hydrocarbon Gas Vapor-Measuring Devices. (3.33.)**

- (a) Leak Test
- (b) Temperature Compensation
- (c) Retention of Customer Invoices

#### **4002.6. Farm Milk Tanks. (4.42.)**

- (a) Calibration and Installation.

#### **4002.8. Liquid-Measuring Devices. (3.30.)**

- (a) Wholesale Devices Equipped With Automatic Temperature Compensating Systems.

NOTE: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

## Sec. 1.10. General Code

### G-A. Application

**G-A.1. Commercial and Law-Enforcement Equipment.** - These specifications, tolerances, and other technical requirements apply as follows:

- (a) To commercial weighing and measuring equipment; that is, to weights and measures and weighing and measuring devices commercially used or employed in establishing the size, quantity, extent, area, or measurement of quantities, things, produce, or articles for distribution or consumption, purchased, offered, or submitted for sale, hire, or award, or in computing any basic charge or payment for services rendered on the basis of weight or measure.
- (b) To any accessory attached to or used in connection with a commercial weighing or measuring device when such accessory is so designed that its operation affects the accuracy of the device.
- (c) To weighing and measuring equipment in official use for the enforcement of law or for the collection of statistical information by government agencies.

(These requirements should be used as a guide by the weights and measures official when, upon request, courtesy examinations of noncommercial equipment are made.)

**G-A.2. Code Application.** - This General Code shall apply to all classes of devices as covered in the specific codes. The specific code requirements supersede General Code requirements in all cases of conflict.  
(Amended 1972)

**G-A.3. Special and Unclassified Equipment.** - Insofar as they are clearly appropriate, the requirements and provisions of the General Code and of specific codes apply to equipment failing, by reason of special design or otherwise, to fall clearly within one of the particular equipment classes for which separate codes have been established. With respect to such equipment, code requirements and provisions shall be applied with due regard to the design, intended purpose, and conditions of use of the equipment.

**G-A.4. Metric Equipment.** - Employment of the weights and measures of the metric system is lawful throughout the United States. These specifications, tolerances, and other requirements shall not be understood or construed as in any way prohibiting the manufacture, sale, or use of equipment designed to give results in terms of metric units. The specific provisions of these requirements and the principles upon which the requirements are based shall be applied to metric equipment insofar as appropriate and practicable. The tolerances on metric

equipment, when not specified herein, shall be equivalent to those specified for similar equipment constructed or graduated in the inch-pound system.

**G-A.5. Retroactive Requirements.** - “Retroactive” requirements are enforceable with respect to all equipment. Retroactive requirements are printed herein in upright Roman type.

**G-A.6. Nonretroactive Requirements.** - “Nonretroactive” requirements are enforceable after the effective date for:

- (a) devices manufactured within a State after the effective date;
- (b) both new and used devices brought into a State after the effective date; and
- (c) devices used in noncommercial applications which are placed into commercial use after the effective date.

Nonretroactive requirements are not enforceable with respect to devices that are in commercial service in the State as of the effective date or to new equipment in the stock of a manufacturer or a dealer in the State as of the effective date.  
*[Nonretroactive requirements are printed in italic type.]*  
(Amended 1989)

**G-A.7. Effective Enforcement Dates of Code Requirements.** - Unless otherwise specified, each new or amended code requirement shall not be subject to enforcement prior to January 1 of the year following the adoption by the National Conference on Weights and Measures and publication by the National Institute of Standards and Technology.

### G-S. Specifications

**G-S.1. Identification.** - All equipment, except weights and separate parts necessary to the measurement process but not having any metrological effect, shall be clearly and permanently marked for the purposes of identification with the following information:

- (a) the name, initials, or trademark of the manufacturer or distributor;
- (b) a model identifier that positively identifies the pattern or design of the device;

*(1) The model identifier shall be prefaced by the word “Model,” “Type,” or “Pattern.” These terms may be followed by the word “Number” or an abbreviation of that word. The abbreviation for the word “Number” shall, as a minimum, begin with the letter “N” (e.g., No or No.) The abbreviation for the word “Model” shall be “Mod” or “Mod.” Prefix lettering may be initial capitals, all capitals, or all lower case.*  
*[Nonretroactive as of January 1, 2003]*

(Added 2000) (Amended 2001, 2004 and 2006)

## 1.10. General Code

- (c) *a nonrepetitive serial number, except for equipment with no moving or electronic component parts and not built-for-purpose, software-based devices;*  
[Nonretroactive as of January 1, 1968]  
(Amended 2003 and 2004)

(1) *The serial number shall be prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the required serial number;*  
[Nonretroactive as of January 1, 1986]

(2) *Abbreviations for the word "Serial" shall, as a minimum, begin with the letter "S," and abbreviations for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., S/N, SN, Ser. No, and S. No).*  
[Nonretroactive as of January 1, 2001]

- (d) *the current software version or revision identifier for not built-for-purpose, software-based devices.*  
[Nonretroactive as of January 1, 2004]

(1) *The version or revision identifier shall be prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the required version or revision.*  
[Nonretroactive as of January 1, 2007]  
(Added 2006)

(2) *Abbreviations for the word "Version" shall, as a minimum, begin with the letter "V" and may be followed by the word "Number." Abbreviations for the word "Revision" shall, as a minimum, begin with the letter "R" and may be followed by the word "Number." The abbreviation for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.).*  
[Nonretroactive as of January 1, 2007]  
(Added 2006)

- (e) *an NTEP Certificate of Conformance (CC) number or a corresponding CC Addendum Number for devices that have a CC. The CC number or a corresponding CC Addendum Number shall be prefaced by the terms "NTEP CC," "CC," or "Approval." These terms may be followed by the term "Number" or an abbreviation of that word. The abbreviation for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.).*  
[Nonretroactive as of January 1, 2003]  
(Added 2001)

The required information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device.  
(Amended 1985, 1991, 1999, 2000, 2003, 2004 and 2006)

**G-S.1.1. Location of Marking Information for Not Built-For-Purpose, Software-Based Devices.** – *For not built-for-purpose, software-based devices either:*

- (a) *The required information in G-S.1 Identification. (a), (b), (d), and (e) shall be permanently marked or continuously displayed on the device; or*

- (b) *The Certificate of Conformance (CC) Number shall be:*

(1) *permanently marked on the device;*

(2) *continuously displayed; or*

(3) *accessible through an easily recognized menu and, if necessary, a submenu. Examples of menu and submenu identification include, but are not limited to, "Help," "System Identification," "G-S.1. Identification," or "Weights and Measures Identification."*

**Note:** *For (b), clear instructions for accessing the information required in G-S.1. (a), (b), and (d) shall be listed on the CC, including information necessary to identify that the software in the device is the same type that was evaluated.*

[Nonretroactive as of January 1, 2004]

(Added 2003) (Amended 2006)

### **G-S.1.2. Remanufactured Devices and Remanufactured Main Elements.**

[NOT ADOPTED]

**G-S.2. Facilitation of Fraud.** - All equipment and all mechanisms, software, and devices attached to or used in conjunction therewith shall be so designed, constructed, assembled, and installed for use such that they do not facilitate the perpetration of fraud.  
(Amended 2007)

**G-S.3. Permanence.** - All equipment shall be of such materials, design, and construction as to make it probable that, under normal service conditions:

- (a) accuracy will be maintained,
- (b) operating parts will continue to function as intended, and
- (c) adjustments will remain reasonably permanent.

Undue stresses, deflections, or distortions of parts shall not occur to the extent that accuracy or permanence is detrimentally affected.

**G-S.4. Interchange or Reversal of Parts.** - Parts of a device that may readily be interchanged or reversed in the course of field assembly or of normal usage shall be:

- (a) so constructed that their interchange or reversal will not affect the performance of the device, or
- (b) so marked as to show their proper positions.

**G-S.5. Indicating and Recording Elements.**

**G-S.5.1. General.** - All weighing and measuring devices shall be provided with indicating or recording elements appropriate in design and adequate in amount. Primary indications and recorded representations shall be clear, definite, accurate, and easily read under any conditions of normal operation of the device.

**G-S.5.2. Graduations, Indications, and Recorded Representations.**

**G-S.5.2.1. Analog Indication and Representation.** Graduations and a suitable indicator shall be provided in connection with indications designed to advance continuously.

**G-S.5.2.2. Digital Indication and Representation.** Digital elements shall be so designed that:

- (a) All digital values of like value in a system agree with one another.
- (b) A digital value coincides with its associated analog value to the nearest minimum graduation.
- (c) A digital value “rounds off” to the nearest minimum unit that can be indicated or recorded.
- (d) *A digital zero indication includes the display of a zero for all places that are displayed to the right of the decimal point and at least one place to the left. When no decimal values are displayed, a zero shall be displayed for each place of the displayed scale division.*  
[Nonretroactive as of January 1, 1986.]  
(Amended 1973 and 1985)

**G-S.5.2.3. Size and Character.** - In any series of graduations, indications, or recorded representations, corresponding graduations and units shall be uniform in size and character. Graduations, indications, or recorded representations that are subordinate to or of a lesser value than others with which they are associated shall be appropriately portrayed or designated.  
[Made retroactive as of January 1, 1975.]

**G-S.5.2.4. Values.** - If graduations, indications, or recorded representations are intended to have specific values, these shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof, uniformly placed with reference to the graduations, indications, or recorded representations and as close thereto as practicable, but not so positioned as to interfere with the accuracy of reading.

**G-S.5.2.5. Permanence.** - Graduations, indications, or recorded representations and their defining figures, words, and symbols shall be of such character that they will not tend easily to become obliterated or illegible.

**G-S.5.3. Values of Graduated Intervals or Increments.** In any series of graduations, indications, or recorded representations, the values of the graduated intervals or increments shall be uniform throughout the series.

**G-S.5.3.1. On Devices That Indicate or Record in More Than One Unit.** - On devices designed to indicate or record in more than one unit of measurement, the values indicated and recorded shall be identified with an appropriate word, symbol, or abbreviation.

(Amended 1978, 1986 and 2006)

**G-S.5.4. Repeatability of Indications.** - A device shall be capable of repeating, within prescribed tolerances, its indications and recorded representations. This requirement shall be met irrespective of repeated manipulation of any element of the device in a manner approximating normal usage (including displacement of the indicating elements to the full extent allowed by the construction of the device and repeated operation of a locking or relieving mechanism) and of the repeated performance of steps or operations that are embraced in the testing procedure.

**G-S.5.5. Money Values, Mathematical Agreement.** - Any recorded money value and any digital money-value indication on a computing-type weighing or measuring device used in retail trade shall be in mathematical agreement with its associated quantity representation or indication to the nearest 1 cent of money value. This does not apply to auxiliary digital indications intended for the operator’s use only, when these indications are obtained from existing analog customer indications that meet this requirement.

(Amended 1973)

**G-S.5.6. Recorded Representations.** - Insofar as they are appropriate, the requirements for indicating and recording elements shall also apply also to recorded representations. All recorded values shall be printed digitally.

(Amended 1975 and 2006)

## 1.10. General Code

Table 1. Representation of SI Units on Equipment Manufactured Prior to January 1, 2008, with Limited Character Sets				
Name of Unit	International Symbol (common use symbol)	Representation		
		Form I	Form II	
		(double case)	(single case lower)	(single case upper)
Base SI units				
Meter	M	M	m	M
Kilogram	Kg	Kg	kg	KG
Derived SI units				
Newton	N	N	n	N
Pascal	Pa	Pa	pa	PA
Watt	W	W	w	W
Volt	V	V	v	V
degree Celsius	°C	°C	°c	°C
Other units				
liter	l or L	L	l	L
gram	G	G	g	G
metric ton	t	t	tne	TNE
bar	bar	bar	bar	BAR

(Amended 2007)

### **G-S.5.6.1. Indicated and Recorded Representation of Units.**

– Appropriate abbreviations.

(Added 1977) (Amended 2007)

(a) For equipment manufactured on or after January 1, 2008, the appropriate defining symbols are shown in NIST Special Publication SP 811 “Guide for the Use of International System of Units (SI)” and Handbook 44 Appendix C – General Tables of Units of Measurement.

**Note:** SP 811 can be viewed or downloaded at <http://physics.nist.gov/cuu/pdf/sp811.pdf> or by going to <http://www.nist.gov/owm> and selecting Weights and Measures Publications and the link to Special Publications, Guide for the Use of the International System of Units (SI) (SP 811).

(Added 2007)

(b) The appropriate defining symbols on equipment manufactured prior to January 1, 2008, with limited character sets are shown in Table 1. Representation of SI Units on Equipment Manufactured Prior to January 1, 2008, with Limited Character Sets.

(Added 1977) (Amended 2007)

**G-S.5.7. Magnified Graduations and Indications.** – All requirements for graduations and indications apply to a series of graduations and an indicator magnified by an optical system or as magnified and projected on a screen.

**G-S.6. Marking Operational Controls, Indications, and Features.** – All operational controls, indications, and features, including switches, lights, displays, pushbuttons, and other

*means, shall be clearly and definitely identified. The use of approved pictograms or symbols shall be acceptable.*

*[Nonretroactive as of January 1, 1977.]*

(Amended 1978, 1995)

**G-S.7. Lettering.** – All required markings and instructions shall be distinct and easily readable and shall be of such character that they will not tend to become obliterated or illegible.

**G-S.8. Provision for Sealing Electronic Adjustable Components.** – A device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.

*[Nonretroactive as of January 1, 1990.]*

A device may be fitted with an automatic or a semiautomatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

(Added 1985) (Amended 1989, 1993)

**G-S.8.1 Multiple Weighing or Measuring Elements that Share a Common Provision for Sealing.** – A change to any metrological parameter (calibration or configuration) of any weighing or measuring element shall be individually identified.

*[Nonretroactive as of January 1, 2010]*

**Note:** For devices that utilize an electronic form of sealing, in addition to the requirements in G-S.8.1., any appropriate audit trail requirements in an applicable

specific device code also apply. Examples of identification of a change to the metrological parameters of a weighing or measuring element include, but are not limited to:

- (1) a broken, missing, or replaced physical seal on an individual weighing, measuring, or indicating element or active junction box;
- (2) a change in a calibration factor or configuration setting for each weighing or measuring element; or
- (3) a display of the date of calibration or configuration event for each weighing or measuring element; or
- (4) counters indicating the number of calibration and/or configuration events for each weighing or measuring element.

(Added 2007)

### G-N. Notes

**G-N.1. Conflict of Laws and Regulations.** - If any particular provisions of these specifications, tolerances, and other requirements are found to conflict with existing State laws, or with existing regulations or local ordinances relating to health, safety, or fire prevention, the enforcement of such provisions shall be suspended until conflicting requirements can be harmonized; and such suspension shall not affect the validity or enforcement of the remaining provisions of these specifications, tolerances, and other requirements.

**G-N.2. Testing With Nonassociated Equipment.** - Tests to determine conditions, such as radio frequency interference (RFI), that may adversely affect the performance of a device shall be conducted with equipment and under conditions that are usual and customary with respect to the location and use of the device.

(Added 1976)

### G-T. Tolerances

**G-T.1. Acceptance Tolerances.** - Acceptance tolerances shall apply to:

- (a) equipment to be put into commercial use for the first time;
- (b) [NOT ADOPTED]
- (c) [NOT ADOPTED]
- (d) [NOT ADOPTED]
- (e) equipment undergoing type evaluation.

(Amended 1989)

**G-T.2. Maintenance Tolerances.** - Maintenance tolerances shall apply to equipment in actual use, except as provided in G-T.1.

**G-T.3. Application.** - Tolerances “in excess” and tolerances “in deficiency” shall apply to errors in excess and to errors in deficiency, respectively. Tolerances “on overregistration” and tolerances “on underregistration” shall apply to errors in the direction of overregistration and of underregistration, respectively. (See Definitions section.)

**G-T.4. For Intermediate Values.** - For a capacity, indication, load, value, etc., intermediate between two capacities, indications, loads, values, etc., listed in a table of tolerances, the tolerances prescribed for the lower capacity, indication, load, value, etc., shall be applied.

### G-UR. User Requirements

#### G-UR.1. Selection Requirements.

##### 4002.1. General Code (1.10.)

**(a) Type Approval Use.** Upon written authorization of the Secretary, a county sealer may allow a device to be used for commercial purposes during a type approval inspection period following initial testing.

**G-UR.1.1. Suitability of Equipment.** - Commercial equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to its weighing capacity (for weighing devices), its computing capability (for computing devices), its rate of flow (for liquid-measuring devices), the character, number, size, and location of its indicating or recording elements, and the value of its smallest unit and unit prices.

(Amended 1974)

**G-UR.1.2. Environment.** - Equipment shall be suitable for the environment in which it is used including but not limited to the effects of wind, weather, and RFI.

(Added 1976)

**G-UR.1.3. Liquid-Measuring Devices.** - To be suitable for its application, the minimum delivery for liquid-measuring devices shall be no less than 100 divisions, except that the minimum delivery for retail analog devices shall be no less than 10 divisions. Maximum division values and tolerances are stated in the specific codes.

(Added 1995)



## 1.10. General Code

### G-UR.2. Installation Requirements.

**G-UR.2.1. Installation.** - A device shall be installed in accordance with the manufacturer's instructions, including any instructions marked on the device. A device installed in a fixed location shall be so installed that neither its operation nor its performance will be adversely affected by any characteristic of the foundation, supports, or any other detail of the installation.

**G-UR.2.1.1. Visibility of Identification.** - Equipment shall be installed in such a manner that all required markings are readily observable.  
(Added 1978)

**G-UR.2.2. Installation of Indicating or Recording Element.** - A device shall be so installed that there is no obstruction between a primary indicating or recording element and the weighing or measuring element; otherwise there shall be convenient and permanently installed means for direct communication, oral or visual, between an individual located at a primary indicating or recording element and an individual located at the weighing or measuring element. [See also G-UR.3.3.]

**G-UR.2.3. Accessibility for Inspection, Testing, and Sealing Purposes.** - A device shall be located, or such facilities for normal access thereto shall be provided, to permit:

- (a) inspecting and testing the device;
- (b) inspecting and applying security seals to the device; and
- (c) readily bringing the testing equipment of the weights and measures official to the device by customary means and in the amount and size deemed necessary by such official for the proper conduct of the test.

Otherwise, it shall be the responsibility of the device owner or operator to supply such special facilities, including such labor as may be needed to inspect, test, and seal the device, and to transport the testing equipment to and from the device, as required by the weights and measures official.  
(Amended 1991)

### G-UR.3. Use Requirements.

**G-UR.3.1. Method of Operation.** - Equipment shall be operated only in the manner that is obviously indicated by its construction or that is indicated by instructions on the equipment.

**G-UR.3.2. Associated and Nonassociated Equipment.** A device shall meet all performance requirements when associated or nonassociated equipment is operated in its usual and customary manner and location.  
(Added 1976)

**G-UR.3.3. Position of Equipment.** - A device or system equipped with a primary indicating element and used in direct sales, except for prescription scales, shall be so positioned that its indications may be accurately read and the weighing or measuring operation may be observed from some reasonable "customer" and "operator" position. The permissible distance between the equipment and a reasonable customer and operator position shall be determined in each case upon the basis of the individual circumstances, particularly the size and character of the indicating element.  
(Amended 1974 and 1998)

**G-UR.3.4. Responsibility, Money-Operated Devices.** - Money-operated devices other than parking meters shall have clearly and conspicuously displayed thereon, or immediately adjacent thereto, adequate information detailing the method for the return of monies paid when the product or service cannot be obtained. This information shall include the name, address, and phone number of the local responsible party for the device. This requirement does not apply to devices at locations where employees are present and responsible for resolving any monetary discrepancies for the customer.  
(Amended 1977, 1993)

### G-UR.4. Maintenance Requirements.

**G-UR.4.1. Maintenance of Equipment.** - All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. Equipment in service at a single place of business found to be in error predominantly in a direction favorable to the device user shall not be considered "maintained in a proper operating condition."  
(Amended 1973, 1991)

**G-UR.4.2. Abnormal Performance.** - Unstable indications or other abnormal equipment performance observed during operation shall be corrected and, if necessary, brought to the attention of competent service personnel.  
(Added 1976)

**G-UR.4.3. Use of Adjustments.** - Weighing elements and measuring elements that are adjustable shall be adjusted only to correct those conditions that such elements are designed to control, and shall not be adjusted to compensate for defective or abnormal installation or accessories or for badly worn or otherwise defective parts of the assembly. Any faulty installation conditions shall be corrected, and any defective parts shall be renewed or suitably repaired, before adjustments are undertaken. Whenever equipment is adjusted, the adjustments shall be so made as to bring performance errors as close as practicable to zero value.

**G-UR.4.4. Assistance in Testing Operations.** - If the design, construction, or location of any device is such as to require a testing procedure involving special equipment or accessories or an abnormal amount of labor, such equipment, accessories, and labor shall be supplied by the owner or operator of the device as required by the weights and measures official.

**G-UR.4.5. Security Seal.** - A security seal shall be appropriately affixed to any adjustment mechanism designed to be sealed.

**G-UR.4.6. Testing Devices at a Central Location.**

- (a) When devices in commercial service require special test facilities, or must be removed from service for testing, or are routinely transported for the purpose of use (e.g., vehicle-mounted devices and devices used in multiple locations), the official with statutory authority may require that the devices be brought to a central location for testing. The dealer or owner of these devices shall provide transportation of the devices to and from the test location.
- (b) When the request for removal and delivery to a central test location involves devices used in submetering (e.g., electric, hydrocarbon vapor, or water meters), the owner or operator shall not interrupt the utility service to the customer or tenant except for the removal and replacement of the device. Provisions shall be made by the owner or operator to minimize inconvenience to the customer or tenant. All replacement or temporary meters shall be tested and sealed by a weights and measure official or bear a current, valid approval seal prior to use.

(Added 1994)

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Table 1M. Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops	
Distance from weighbeam fulcrum to limiting stops (centimeters)	Minimum travel between limiting stops (millimeter)
30 or less	10
30+ to 50, inclusive	13
50+ to 100, inclusive	18
Over 100	23

Table 1. Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops	
Distance from weighbeam fulcrum to limiting stops (inches)	Minimum travel Between limiting stops (inch)
12 or less	0.4
12+ to 20, inclusive	0.5
20+ to 40, inclusive	0.7
Over 40	0.9

**S.1.5.3. Subdivision.** - A subdivided weighbeam bar shall be subdivided by scale division graduations, notches, or a combination of both. Graduations on a particular bar shall be of uniform width and perpendicular to the top edge of the bar. Notches on a particular bar shall be uniform in shape and dimensions and perpendicular to the face of the bar. When a combination of graduations and notches is employed, the graduations shall be positioned in relation to the notches to indicate notch values clearly and accurately.

**S.1.5.4. Readability.** - A subdivided weighbeam bar shall be so subdivided and marked, and a weighbeam poise shall be so constructed, that the weight corresponding to any normal poise position can easily and accurately be read directly from the beam, whether or not provision is made for the optional recording of representations of weight.

**S.1.5.5. Capacity.** - On an automatic-indicating scale having a nominal capacity of 15 kg (30 lb) or less and used for direct sales to retail customers:

- (a) the capacity of any weighbeam bar shall be a multiple of the reading-face capacity,

- (b) each bar shall be subdivided throughout or shall be subdivided into notched intervals, each equal to the reading-face capacity; and

- (c) the value of any turnover poise shall be equal to the reading-face capacity

**S.1.5.6. Poise Stop.** - Except on a steelyard with no zero graduation, a shoulder or stop shall be provided on each weighbeam bar to prevent a poise from traveling and remaining back of the zero graduation.

#### S.1.6. Poes.

**S.1.6.1. General.** - No part of a poise shall be readily detachable. A locking screw shall be perpendicular to the longitudinal axis of the weighbeam and shall not be removable. Except on a steelyard with no zero graduation, a poise shall not be readily removable from a weighbeam. The knife edge of a hanging poise shall be hard and sharp and so constructed as to allow the poise to swing freely on the bearing surfaces in the weighbeam notches.

**S.1.6.2. Adjusting Material.** - The adjusting material in a poise shall be securely enclosed and firmly fixed in position; if softer than brass, it shall not be in contact with the weighbeam.

**S.1.6.3. Pawl.** - A poise, other than a hanging poise, on a notched weighbeam bar shall have a pawl that will seat the poise in a definite and correct position in any notch, wherever in the notch the pawl is placed, and hold it there firmly and without appreciable movement. The dimension of the tip of the pawl that is transverse to the longitudinal axis of the weighbeam shall be at least equal to the corresponding dimension of the notches.

**S.1.6.4. Reading Edge or Indicator.** - The reading edge or indicator of a poise shall be sharply defined, and a reading edge shall be parallel to the graduations on the weighbeam.

#### S.1.7. Capacity Indication, Weight Ranges, and Unit Weights.

- (a) **Gross Capacity.** An indicating or recording element shall not display nor record any values when the gross load (not counting the initial dead load that has been canceled by an initial zero-setting mechanism) is in excess of 105 percent of scale capacity.

- (b) **Capacity Indication.** *Electronic computing scales (excluding postal scales and weight classifiers) shall neither display nor record a gross or net weight in excess of scale capacity plus 9d.*

## 2.20. Scales

The total value of weight ranges and of unit weights in effect or in place at any time shall automatically be accounted for on the reading face and on any recorded representation.

This requirement does not apply to: (1) single-revolution dial scales, (2) multi-revolution dial scales not equipped with unit weights, (3) scales equipped with two or more weighbeams, nor (4) devices that indicate mathematically derived totaled values.

*[Nonretroactive as of January 1, 1993.]*

(Amended 1990, 1992, and 1995)

### S.1.8. Computing Scales.

**S.1.8.1.M. Money-Value Graduations, Metric Unit Prices.** - The value of the graduated intervals representing money values on a computing scale with analog indications shall not exceed:

- (a) 1 cent at all unit prices of 55 cents per kilogram and less;
- (b) 2 cents at unit prices of 56 cents per kilogram through \$2.75 per kilogram (special graduations defining 5-cent intervals may be employed but not in the spaces between regular graduations);
- (c) 5 cents at unit prices of \$2.76 per kilogram through \$7.50 per kilogram; or
- (d) 10 cents at unit prices above \$7.50 per kilogram.

Value figures and graduations shall not be duplicated in any column or row on the graduated chart. (See also S.1.8.2.)

**S.1.8.1. Money-Value Graduations, Inch-Pound Unit Prices.** - The value of the graduated intervals representing money values on a computing scale with analog indications shall not exceed:

- (a) 1 cent at all unit prices of 25 cents per pound and less;
- (b) 2 cents at unit prices of 26 cents per pound through \$1.25 per pound (special graduations defining 5-cent intervals may be employed but not in the spaces between regular graduations);
- (c) 5 cents at unit prices of \$1.26 per pound through \$3.40 per pound; or
- (d) 10 cents at unit prices above \$3.40 per pound.

Value figures and graduations shall not be duplicated in any column or row on the graduated chart. (See also S.1.8.2.)

**S.1.8.2. Money-Value Computation.** - A computing scale with analog quantity indications used in retail trade may compute and present digital money values to the nearest quantity graduation when the value of the minimum graduated interval is 0.005 kg (0.01 lb) or less. (Also see Sec. 1.10; G-S.5.5.)

### S.1.8.3. Customer's Indications.

**[NOT ADOPTED]**

## 4002.2. Scales (2.20.)

**(e) Customer's Indications.** Weight indications shall be shown on the customer's side of computing scales when these are used for direct sales to retail customers. Computing scales equipped on the operator's side with digital indications, such as the net weight, unit price, or total price, shall be similarly equipped on the customer's side. *Unit price displays visible to the customer shall be in terms of whole units of weight, and not in common or decimal fractions.*

*[Nonretroactive May 9, 1996.]*

**S.1.8.3.1.** Scales that will function as either a normal round off scale or as a weight classifier shall be provided with a sealable means for selecting the mode of operation and shall have a clear indication (annunciator), adjacent to the weight display on both the operator's and customer's side whenever the scale is operating as a weight classifier.

*[Nonretroactive as of January 1, 2001]*

(Added 1999)

**S.1.8.4. Recorded Representations, Point-of-Sale Systems.** - The sales information recorded by cash registers when interfaced with a weighing element shall contain the following information for items weighed at the checkout stand:

- (a) the net weight,<sup>1</sup>
- (b) the unit price,<sup>1</sup>

<sup>1</sup> For devices interfaced with scales indicating in metric units, the unit price may be expressed in price per 100 grams. Weight values shall be identified by kilogram, kg, grams, g, ounces, oz, pound, or lb. The “#” symbol is not acceptable. *[Nonretroactive as of January 1, 2006]*  
(Amended 1995 and 2005)

- (c) the total price, and
- (d) the product class or, in a system equipped with price look-up capability, the product name or code number.

### S.1.9. Prepackaging Scales.

**S.1.9.1. Value of the Scale Division.** - On a prepackaging scale, the value of the intervals representing weight values shall be uniform throughout the entire reading face. The recorded weight values shall be identical with those on the indicator.

**S.1.9.2. Label Printer.** - A prepackaging scale or a device that produces a printed ticket to be used as the label for a package shall print all values digitally and of such size, style of type, and color as to be clear and conspicuous on the label.

**S.1.10. Adjustable Components.** - An adjustable component such as a pendulum, spring, or potentiometer shall be held securely in adjustment and, except for a zero-load balance mechanism, shall be located within the housing of the element.  
(Added 1986)

#### S.1.11. Provision for Sealing.

- (a) *Except on Class I scales, provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of*

*an electronic device.*

*[Nonretroactive as of January 1, 1979.]*

- (b) *Except on Class I scales, a device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.*

*[Nonretroactive as of January 1, 1990.]*

- (c) *Except on Class I scales, audit trails shall use the format set forth in Table S.1.11.*

*[Nonretroactive as of January 1, 1995.]*

A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

(Amended 1989, 1991, 1993)

**S.1.12. Manual Weight Entries.** - A device when being used for direct sale shall accept an entry of a manual gross or net weight value only when the scale gross or net\* weight indication is at zero. Recorded manual weight entries, except those on labels generated for packages of standard weights, shall identify the weight value as a manual weight entry by one of the following terms: "Manual Weight," "Manual Wt," or "MAN WT." The use

Table S.1.11. Categories of Device and Methods of Sealing	
Categories of Device	Method of Sealing
Category 1: No remote configuration capability.	Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 2: Remote configuration capability, but access is controlled by physical hardware.  Device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.	The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).	An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. ( <b>Note: Does not require 1000 changes to be stored for each parameter.</b> )

*[Nonretroactive as of January 1, 1995.]*

(Table added 1993)

## 2.20. Scales

*of a symbol to identify multiple manual weight entries on a single document is permitted, provided that the symbol is defined on the same page on which the manual weight entries appear and the definition of the symbol is automatically printed by the recording element as part of the document.*

*[Nonretroactive as of January 1, 1993]*

*[\*Nonretroactive as of January 1, 2005]*

(Added 1992) (Amended 2004)

**S.1.13. Vehicle On-Board Weighing Systems: Vehicle in Motion.** - When the vehicle is in motion, a vehicle on-board weighing system shall either:

- (a) be accurate; or
  - (b) inhibit the weighing operation.
- (Added 1993)

## **S.2. Design of Balance, Tare, Level, Damping, and Arresting Mechanisms.**

### **S.2.1. Zero-Load Adjustment.**

**S.2.1.1. General.** - A scale shall be equipped with means by which the zero-load balance may be adjusted. Any loose material used for this purpose shall be enclosed so that it cannot shift in position and alter the balance condition of the scale.

**S.2.1.2. Scales Used in Direct Sales.** - A manual zero-setting mechanism (except on a digital scale with an analog zero-adjustment mechanism with a range of not greater than one scale division) shall be operable or accessible only by a tool outside of and entirely separate from this mechanism, or it shall be enclosed in a cabinet. Except on Class I or II scales, a balance ball shall either meet this requirement or not itself be rotatable.

A semiautomatic zero-setting mechanism shall be operable or accessible only by a tool outside of and separate from this mechanism or it shall be enclosed in a cabinet, or it shall be operable only when the indication is stable within:

- (a) plus or minus 3 scale divisions for scales of more than 2 000 kg (5 000 lb) capacity in service prior to January 1, 1981, and for all axle-load, railway track, and vehicle scales; or
- (b) plus or minus 1 scale division for all other scales.

**S.2.1.3. Scales Equipped with an Automatic Zero-Tracking Mechanism.** -

**S.2.1.3.1. Automatic Zero-Tracking Mechanism for Scales Manufactured Between January 1, 1981 and January 1, 2007.** - The maximum load that can be "rezeroed," when either placed on or removed from the platform all at once under normal operating conditions, shall be:

- (a) for bench, counter, and livestock scales: 0.6 scale division;
  - (b) for vehicle, axle-load, and railway track scales: 3.0 scale divisions; and
  - (c) for all other scales: 1.0 scale division.
- (Amended 2005)

**S.2.1.3.2. Automatic Zero-Tracking Mechanism for Scales Manufactured on or after January 1, 2007.** - The maximum load that can be "rezeroed," when either placed on or removed from the platform all at once under normal operating conditions, shall be:

- (a) for vehicle, axle-load, and railway track scales: 3.0 scale divisions; and
  - (b) for all other scales: 0.5 scale division.
- (Added 2005)

**S.2.1.3.3. Means to Disable Automatic Zero-Tracking Mechanism On Class III L Devices.** - *Class III L devices equipped with an automatic zero-tracking mechanism shall be designed with a sealable means that would allow zero tracking to be disabled during the inspection and test of the device.*

*[Nonretroactive as of January 1, 2001]*

(Added 1999) (Amended 2005 and 2006)

**S.2.1.4. Monorail Scales.** - On a static monorail scale equipped with digital indications, means shall be provided for setting the zero-load balance to within 0.02 percent of scale capacity. On a dynamic monorail weighing system, means shall be provided to automatically maintain these conditions.

(Amended 1999)

### **S.2.1.5. Initial Zero-Setting Mechanism.**

- (a) Scales of accuracy Classes I, II, and III may be equipped with an initial zero-setting device.
  - (b) An initial zero-setting mechanism shall not zero a load in excess of 20 percent of the maximum capacity of the scale unless tests show that the scale meets all applicable tolerances for any amount of initial load compensated by this device within the specified range.
- (Added 1990)

Table S.6.3.b.

## Notes For Table S.6.3.a

1. Manufacturer's identification and model designation and model designation prefix*. *[Nonretroactive as of January 1, 2003.] (See G-S.1.) [Prefix lettering may be initial capitals, all capitals or all lower case.] (Amended 2000)	<i>maximum number of scale divisions for which the device complies with the applicable requirements for each accuracy class.</i> [Nonretroactive as of January 1, 1988.]
2. Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986]. (See G-S.1.)	9. For vehicle and axle-load scales only. The CLC shall be added to the load-receiving element of any such scale not previously marked at the time of modification. [Nonretroactive as of January 1, 1989.] (Amended 2002)
3. The device shall be marked with the nominal capacity. The nominal capacity shall be shown together with the value of the scale division (e.g., 15 x 0.005 kg, 30 x 0.01 lb, or capacity = 15 kg, d = 0.005 kg) in a clear and conspicuous manner and be readily apparent when viewing the reading face of the scale indicator unless already apparent by the design of the device. Each scale division value or weight unit shall be marked on multiple range or multi-interval scales. [Nonretroactive as of January 1, 1983] (Amended 2005)	10. Necessary to the weighing system but having no metrological effect, e.g., auxiliary remote display, keyboard, etc.
4. Required only if different from "d." [Nonretroactive as of January 1, 1986.]	11. The markings may be either on the load cell or in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document. [Nonretroactive as of January 1, 1988.] The manufacturer's name or trademark, the model designation, and identifying symbol for the serial number shall also be marked both on the load cell and in any accompanying document. [Nonretroactive as of January 1, 1991.]
5. Required only on Class III, III L, and IIII devices if the temperature range on the NTEP CC is narrower than and within -10 °C to 40 °C (14 °F to 104 °F). [Nonretroactive as of January 1, 1986.]	12. Required on the indicating element and the load-receiving element of vehicle and axle-load scales. Such marking shall be identified as "concentrated load capacity" or by the abbreviation "CLC".* [*Nonretroactive as of January 1, 1989.] (Amended 2002)
6. This value may be stated on load cells in units of 1 000; e.g., n: 10 is 10 000 divisions. [Nonretroactive as of January 1, 1988.]	13. A scale designed for a special application rather than general use shall be conspicuously marked with suitable words, visible to the operator and to the customer, restricting its use to that application, e.g., postal scale, prepack scale, weight classifier, etc.* When a scale is installed with an operational counting feature, the scale shall be marked on both the operator and customer sides with the statement "The counting feature is not legal for trade," except when a Class I or Class II prescription scale complies with all Handbook 44 requirements applicable to counting features. [*Nonretroactive as of January 1, 1986.] (Amended 1994 and 2003)
7. Denotes compliance for single or multiple load cell applications. It is acceptable to use a load cell with the "S" or Single Cell designation in multiple load cell applications as long as all other parameters meet applicable requirements. A load cell with the "M" or Multiple Cell designation can be used only in multiple load cell applications. [Nonretroactive as of January 1, 1988.] (Amended 1999)	14. Required on livestock* and railway track scales. When marked on vehicle and axle-load scales manufactured before January 1, 1989, it may be used as the CLC. For livestock scales manufactured between January 1, 1989 and January 1, 2003, required markings may be either CLC or section capacity. [*Nonretroactive as of January 1, 2003.] (Amended 2002 and 2003)
8. An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class of I, II, III, III L, or IIII, as appropriate, and the maximum number of scale divisions, $n_{max}$ , for which the indicator complies with the applicable requirement. Indicating elements that qualify for use in both Class III and III L applications may be marked III/III L and shall be marked with the	



Table S.6.3.b.

## Notes For Table S.6.3.a. (Continued)

- |  |  |
|--|--|
| <p>15. <i>Required if the direction of loading the load cell is not obvious.</i><br/>[Nonretroactive as of January 1, 1988.]</p> <p>16. <i>Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986].</i> (See G-S.1.) Modules without “intelligence” on a modular system (e.g., printer, keyboard module, cash drawer, and secondary display in a point-of-sale system) are not required to have serial numbers.</p> <p>17. <i>The accuracy Class of a device shall be marked on the device with the appropriate designation as I, II, III, III L, or IIII.</i><br/>[Nonretroactive as of January 1, 1986.]</p> <p>18. The nominal capacity shall be conspicuously marked as follows:</p> <p style="margin-left: 20px;">(a) on any scale equipped with unit weights or weight ranges;</p> <p style="margin-left: 20px;">(b) on any scale with which counterpoise or equal-arm weights are intended to be used;</p> <p style="margin-left: 20px;">(c) on any automatic-indicating or recording scale so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent;</p> <p style="margin-left: 20px;">(d) on any scale with a nominal capacity less than the sum of the reading elements; and</p> <p style="margin-left: 20px;">(e) on the load-receiving element (weighbridge) of vehicle, axle-load, and livestock scales.*<br/>[*Nonretroactive as of January 1, 1989.]</p> <p>19. <i>Nonretroactive as of January 1, 1988.</i><br/>(Amended 1992)</p> | <p>20. <i>Combination vehicle/railway track scales must be marked with both the nominal capacity and CLC for vehicle weighing and the nominal capacity and section capacity for railway weighing. All other requirements relating to these markings will apply.</i><br/>[Nonretroactive as of January 1, 2000]<br/>(Added 1999)</p> <p>21. The value of the load cell verification interval (<math>v_{min}</math>) must be stated in mass units. In addition to this information, a device may be marked with supplemental representations of <math>v_{min}</math>.<br/>[Nonretroactive as of January 1, 2001]<br/>(Added 1999)</p> <p>22. <i>Combination vehicle/livestock scales must be marked with both the CLC for vehicle weighing and the section capacity for livestock weighing. All other requirements relative to these markings will apply.</i><br/>[Nonretroactive as of January 1, 2003]<br/>(Added 2002)</p> <p style="margin-left: 20px;"><b>Note:</b> <i>The marked section capacity for livestock weighing may be less than the marked CLC for vehicle weighing.</i><br/>(Added 2003)</p> <p>23. <i>Required only if a CC has been issued for the device or equipment.</i><br/>[Nonretroactive as of January 1, 2003]<br/>(G-S.1. Identification (f) Added 2001)</p> <p>24. <i>The section capacity shall be prefaced by the words “Section Capacity” or an abbreviation of that term. Abbreviations shall be “Sec Cap” or “Sec C”. All capital letters and periods may be used.</i><br/>[Nonretroactive as of January 1, 2005]<br/>(Added 2004)</p> |
|--|--|

**N.1.2.1. Scales Marked I, II, III, or IIII.** - Except for portable wheel load weighers, decreasing-load tests shall be conducted on scales marked I, II, III, or IIII and with  $n$  equal to or greater than 1000 with test loads equal to the maximum test load at each tolerance value. For example, on a Class III scale, at test loads equal to 4000d, 2000d, and 500d; for scales with  $n$  less than 1000, the test load shall be equal to one-half of the maximum load applied in the increasing-load test. (See Table 6.)  
(Amended 1998)

**N.1.2.2. All Other Scales.** - On all other scales, except for portable wheel load weighers, the decreasing-load test shall be conducted with a test load equal to one-half of the maximum load applied in the increasing-load test.  
(Amended 1998)

**N.1.3. Shift Test.**

**N.1.3.1. Dairy-Product-Test Scales.** - A shift test shall be conducted with a test load of 18 g successively positioned at all points on which a weight might reasonably be placed in the course of normal use of the scale.

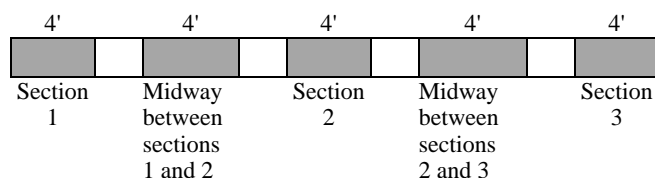
**N.1.3.2. Equal-Arm Scales.** - A shift test shall be conducted with a half-capacity test load centered successively at four points positioned equidistance between the center and the front, left, back, and right edges of each pan as shown in the diagrams below. An equal test load shall be centered on the other pan.

### N.1.3.3. Vehicle Scales, Axle-Load Scales, and Livestock Scales.

#### N.1.3.3.1. Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.

- (a) **Minimum Shift Test.** At least one shift test shall be conducted with a minimum test load of 12.5% of scale capacity, which may be performed anywhere on the load-receiving element using the prescribed test patterns and maximum test loads specified below. (Combination Vehicle/Livestock Scales shall also be tested consistent with N.1.3.3.2. Prescribed Test Pattern and Test Loads for Livestock Scales with More Than Two Sections and Combination Vehicle/Livestock Scales.)  
(Amended 1991, 2000 and 2003)

- (b) **Prescribed Test Pattern and Loading for Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.** The normal prescribed test pattern shall be an area of 1.2 m (4 ft) in length and 3.0 m (10 ft) in width or the width of the scale platform, whichever is less. Multiple test patterns may be utilized when loaded in accordance with Paragraph (c) (d), or (e) as applicable. An example of a possible test pattern is shown in the diagram below.  
(Amended 1997, 2001 and 2003)



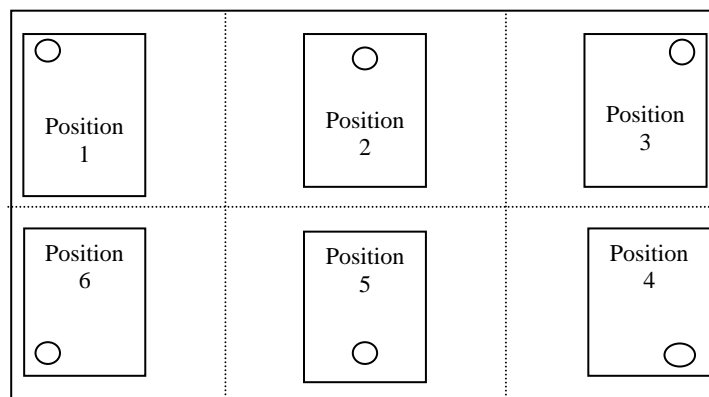
- (c) **Loading Precautions for Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.** When loading the scale for testing, one side of the test pattern shall be loaded to no more than half of the concentrated load capacity or test load before loading the other side. The area covered by the test load may be less than 1.2 m (4 ft) x 3.0 m (10 ft) or the width of the scale platform; whichever is less; for test patterns less than 1.2 m (4 ft) in length the maximum loading shall meet the formula: [(wheel base of test cart or length of test load divided by 48 in) x 0.9 x CLC]. The maximum test load applied to each test pattern shall not exceed the concentrated load capacity of the scale. When the test pattern exceeds 1.2 m (4 ft), the maximum test load applied shall not exceed the concentrated load capacity times the largest "r" factor in Table UR.3.2.1. for the length of the area covered by the test

load. For load-receiving elements installed prior to January 1, 1989, the rated section capacity may be substituted for concentrated load capacity to determine maximum loading. An example of a possible test pattern is shown above.

(Amended 1997 and 2003)

- (d) **Multiple Pattern Loading.** To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.
- (e) **Other Designs.** Special design scales and those that are wider than 3.7 m (12 ft) shall be tested in a manner consistent with the method of use but following the principles described above.  
(Amended 1988, 1991, 1997, 2000, 2001, and 2003)  
(Amended 2003)

**N.1.3.3.2. Prescribed Test Pattern and Test Loads for Livestock Scales with More Than Two Sections and Combination Vehicle/Livestock Scales.** – A minimum test load of 5000 kg (10 000 lb) or one-half of the rated section capacity, whichever is less, shall be placed, as nearly as possible, successively over each main load support as shown in the diagram below. For livestock scales manufactured between January 1, 1989, and January 1, 2003, the required loading shall be no greater than one-half CLC. (Two-section livestock scales shall be tested consistent with N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers)



○ = Load Bearing Point

(Added 2003)

**N.1.3.3.3. Prescribed Test Patterns and Test Loads for Two-Section Livestock Scales.** – A shift test shall be conducted using the following prescribed test loads and test patterns, provided the shift test load does not exceed one-half the rated section capacity or one-half the rated concentrated load capacity whichever is applicable, using either:

## 2.20. Scales

(a) A one-half nominal capacity test load centered as nearly as possible, successively at the center of each quarter of the load-receiving element as shown in N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers Figure 1; or

(b) A one-quarter nominal capacity test load centered as nearly as possible, successively over each main load support as shown in N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers Figure 2.

(Added 2007)

**N.1.3.4. Railway Track Scales Weighing Individual Cars in Single Drafts.** - A shift test shall be conducted with at least two different test loads, if available, distributed over, to the right and left of, each pair of main levers or other weighing elements supporting each section of the scale.

**N.1.3.5. Monorail Scales, Static Test.** - A shift test shall be conducted with a test load equal to the largest load that can be anticipated to be weighed in a given installation, but never less than one-half scale capacity. The load shall be placed successively on the right end, the left end, and the center of the live rail.

(Added 1985)

**N.1.3.5.1. Dynamic Monorail Weighing Systems.** - Dynamic tests with livestock carcasses or portions of carcasses shall be conducted during normal plant production. No less than 20 test loads using carcasses or portions of carcasses of the type normally weighed shall be used in the dynamic test. If the plant conveyor chain does not space or prevent the carcasses or portions of carcasses from touching one another, dynamic tests shall not be conducted until this condition has been corrected.

All carcasses or portions of carcasses shall be individually weighed statically on either the same scale being tested dynamically or another monorail scale with the same or smaller divisions and in close proximity. (The scale selected for static weighing of the carcasses or portions of carcasses shall first be tested statically with certified test weights that have been properly protected from the harsh environment of the packing plant to ensure they maintain accuracy.)

If the scale being tested is used for weighing freshly slaughtered animals (often referred to as a "hot scale"), care must be taken to get a static weightment as quickly as possible before or following the dynamic weightment to avoid loss due to shrink. If multiple dynamic tests are

conducted using the same carcasses or portions of carcasses, static weights shall be obtained before and after multiple dynamic tests. If the carcass or portion of a carcass changes weight between static tests, the amount of weight change shall be taken into account, or the carcass or portion of a carcass shall be disregarded for tolerance purposes.

**(Note:** For a dynamic monorail test, the reference scale shall comply with the principles in the Fundamental Considerations paragraph 3.2. Tolerances for Standards.)

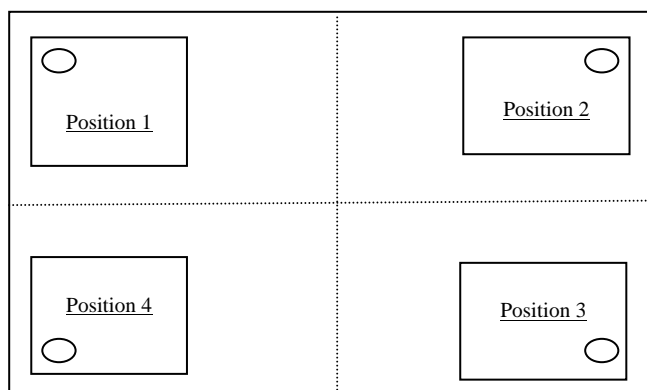
(Added 1996) (Amended 1999 and 2007)

**N.1.3.6. Vehicle On-Board Weighing Systems.** - The shift test for a vehicle on-board weighing system shall be conducted in a manner consistent with its normal use. For systems that weigh as part of the lifting cycle, the center of gravity of the load may be shifted in the vertical direction as well as from side to side. In other cases, the center of gravity may be moved to the extremes of the load-receiving element using loads of a magnitude that reflect normal use (i.e., the load for the shift test may exceed one-half scale capacity), and may, in some cases, be equal to the capacity of the scale. The shift test may be conducted when the weighing system is out-of-level to the extent that the weighing system remains operational.

(Added 1992)

**N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers.** - A shift test shall be conducted using the following prescribed test loads and test patterns. A single field standard weight used as the prescribed test load shall be applied centrally in the prescribed test pattern. When multiple field standard weights are used as the prescribed test load, the load shall be applied in a consistent pattern in the shift test positions throughout the test and applied in a manner that does not concentrate the load in a test pattern that is less than when that same load is a single field standard weight on the load-receiving element.

(a) For scales with a nominal capacity of 500 kg (1000 lb) or less, a shift test shall be conducted using a one-third nominal test load (defined as test weights in amounts of at least 30% of scale capacity, but not to exceed 35% of scale capacity) centered as nearly as possible at the center of each quadrant of the load-receiving element using the prescribed test pattern as shown in Figure 1.

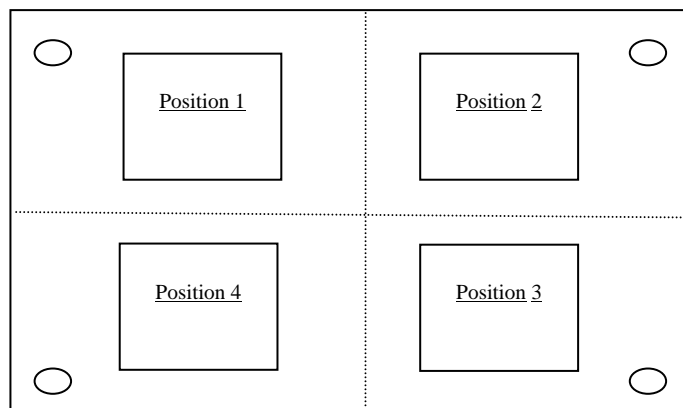


○ = Load Bearing

(Added 2003)

(Amended 1987, 2003, and 2007)

- (b) For scales with a nominal capacity greater than 500 kg (1000 lb), a shift test may be conducted by either using a one-third nominal capacity test load (defined as test weights in amounts of at least 30% of scale capacity, but not to exceed 35% of scale capacity) centered as nearly as possible at the center of each quadrant of the load-receiving element using the prescribed test pattern as shown in Figure 1, or by using a one-quarter nominal capacity test load centered as nearly as possible, successively, over each corner of the load-receiving element using the prescribed test pattern as shown in Figure 2.



○ = Load Bearing Point

(Added 2003)

(Amended 1987, 2003, and 2007)

**N.1.4. Sensitivity Test.** - A sensitivity test shall be conducted on nonautomatic-indicating (weighbeam) scales only, with the weighing device in equilibrium at zero-load and at maximum test load. The test shall be conducted by increasing or decreasing the test load in an amount equal to the applicable value specified in T.2. or T.N.6.

**N.1.5. Discrimination Test.** - A discrimination test shall be conducted on all automatic indicating scales with the

weighing device in equilibrium at or near zero load and at or near maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained. For scales equipped with an Automatic Zero-Tracking Mechanism (AZT), the discrimination test may be conducted at a range outside of the AZT range.

[Nonretroactive as of January 1, 1986.]

(Added 1985) (Amended 2004)

**N.1.5.1. Digital Device.** - On a digital device, this test is conducted from just below the lower edge of the zone of uncertainty for increasing load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

**N.1.6. RFI Susceptibility Tests, Field Evaluation.** - An RFI test shall be conducted at a given installation when the presence of RFI has been verified and characterized if those conditions are considered “usual and customary.”

(Added 1986)

**N.1.7. Ratio Test.** - A ratio test shall be conducted on all scales employing counterpoise weights and on nonautomatic-indicating equal-arm scales.

**N.1.8. Material Tests.** - A material test shall be conducted on all customer-operated bulk weighing systems for recycled materials using bulk material for which the device is used. Insert into the device, in a normal manner, several accurately preweighed samples (free of foreign material) in varying amounts approximating average drafts.

**N.1.9. Zero-Load Balance Change.** - A zero-load balance change test shall be conducted on all scales after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (Also see G-UR.4.2.) (Renumbered 1988)

**N.1.10. Counting Feature Test.** - A test of the counting function shall be conducted on all Class I and Class II prescription scales having an active counting feature used in “legal for trade” applications. The test should verify that the scale will not accept a sample with less than either the minimum sample piece count or the minimum sample weight of 30 e. Counting feature accuracy should be verified at a minimum of two test loads. Verification of the count calculations shall be based upon the weight indication of the test load.

**Note:**

- (1) The minimum sample weight is equal to the marked minimum individual piece weight times the marked minimum sample piece count.
- (2) Test load as used in this section refers to actual calibration test weights selected from an appropriate test weight class.

(Added 2003)

## 2.20. Scales

**N.1.11. Substitution Test.** – In the substitution test procedure, material or objects are substituted for known test weights, or a combination of known test weights and previously quantified material or objects, using the scale under test as a comparator. Additional test weights or other known test loads may be added to the known test load to evaluate higher weight ranges on the scale.

(Added 2003)

**N.1.12. Strain-Load Test.** – In the strain load test procedure, an unknown quantity of material or objects are used to establish a reference load or tare to which test weights or substitution test loads are added.

(Added 2003)

**N.2. Verification (Testing) Standards.** - Field standard weights used in verifying weighing devices shall comply with requirements of NIST Handbook 105-1 (Class F) or the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied). (Amended 1986)

**N.3. Minimum Test Weights and Test Loads\*.**

[NOT ADOPTED]

### 4002.2 Scales (2.20)

(a) **Recommended Minimum<sup>2</sup> Test Weights and Test Loads.<sup>1</sup>** The recommended<sup>2</sup> minimum test weights and test loads for in-service tests (except railway track scales) are shown in Table 4. [See Table 4 for <sup>1</sup> and <sup>2</sup>]

**N.3.1. Minimum Test-Weight Load and Recommended Strain-Load Test for Railway Track Scales.**

(Amended 1990)

**N.3.1.1. Approval.** - The test-weight load shall be not less than 35 000 kg (80 000 lb). A strain-load test conducted up to the used capacity of the weighing system is recommended.

(Added 1990)

**N.3.1.2. Interim Approval.** - A test-weight load of not less than 13 500 kg (30 000 lb) and a strain-load test up to at least 25 percent of scale capacity may be used to return a scale into service following repairs.

(Added 1990)

Note: The length of time the scale may be used following an interim test is at the discretion of the official with statutory authority.

(Added 1990)

**N.3.1.3. Enforcement Action for Inaccuracy.** - To take enforcement action on a scale that is found to be inaccurate, a minimum test load of 13 500 kg (30 000 lb) must be used.

(Added 1990)

**N.3.2. Field Standard Weight Carts.** – Field Standard Weight Carts that comply with the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied) may be included as part of the minimum required test load (see Table 4) for shift tests and other test procedures.

(Added 2004)

## N.4. Coupled-in-Motion Railroad Weighing Systems.<sup>3</sup>

**N.4.1. Weighing Systems Used to Weigh Trains of Less Than 10 Cars.** - These weighing systems shall be tested using a consecutive-car test train consisting of the number of cars weighed in the normal operation run over the weighing system a minimum of five times in each mode of operation following the final calibration.

(Added 1990; Amended 1992)

**N.4.2. Weighing Systems Placed in Service Prior to January 1, 1991, and Used to Weigh Trains of 10 or More Cars.** - The minimum test train shall be a consecutive-car test train of no less than 10 cars run over the scale a minimum of five times in each mode of operation following final calibration.

(Added 1990; Amended 1992)

**N.4.3. Weighing Systems Placed in Service on or After January 1, 1991, and Used to Weigh Trains of 10 or More Cars.**

(a) These weighing systems shall be tested using a consecutive-car test train of no less than 10 cars run over the scale a minimum of five times in each mode of operation following final calibration; or

(b) if the official with statutory authority determines it necessary, the As Used Test Procedures outlined in N.4.3.1. shall be used.

(Added 1990; Amended 1992)

**N.4.3.1. As Used Test Procedures** - A weighing system shall be tested in a manner that represents the normal method of operation and length(s) of trains normally weighed. The weighing systems may be tested using either:

(1) a consecutive-car test train of a length typical of train(s) normally weighed; or

(2) a distributed-car test train of a length typical of train(s) normally weighed.

<sup>3</sup> A test weight car that is representative of one of the types of cars typically weighed on the scale under test may be used wherever reference weight cars are specified.

(Added 1991)

**TABLE 4. RECOMMENDED<sup>2</sup> MINIMUM TEST WEIGHTS AND TEST LOADS<sup>1</sup>**

Device Capacity (Pounds)	Recommended <sup>2</sup> minimums (in terms of device capacity)		Recommended <sup>2</sup> (where practicable)
	Test Weights (greater of)	Test Loads	
0 to 100	105%		
101 to 1,000	50% or 100 lb	105%	
1,001 to 40,000	25% or 500 lb	50%	Test weights to dial face capacity, 1,000d or test load to used capacity, if greater than minimums specified
40,000 +	12.5% or 10,000 lb	25%	

<sup>1</sup> The term “test load” means the sum of the combination of field standard test weights and any other applied load used in the conduct of a test using substitution or build-up test methods.

Except for railway track scales, the recommended<sup>2</sup> minimum test of a Class III L scale shall consist of one test from zero to at least 25% of the scale capacity and then one strain load test to at least the used capacity of the device.

Each test is to be conducted using a known test load of at least 25% of scale capacity. This test load may be comprised entirely of test weights or a combination of test weights equal to at least 12.5% of scale capacity and a substitution load.

<sup>2</sup> The word “Recommended” will be deleted from this section as of January 1, 1998. This will make the amounts of test weights and test loads specified in Table 4 mandatory as of January 1, 1998.

However, a consecutive-car test train of a shorter length may be used provided that initial verification test results for the shorter consecutive-car test train agree with the test results for the distributed-car or full-length consecutive-car test train as specified in N.4.3.1.1.

The official with statutory authority shall be responsible for determining the minimum test train length to be used on subsequent tests.  
(Added 1990; Amended 1992)

**N.4.3.1.1. Initial Verification.** - Initial verification tests should be performed on any new weighing system and whenever either the track structure or the operating procedure changes. If a consecutive-car test train of length shorter than trains normally weighed is to be used for subsequent verification, the shorter consecutive-car test train results shall be compared either to a distributed-car or to a consecutive-car test train of length(s) typical of train(s) normally weighed.

The difference between the total train weight of the train(s) representing the normal method of operation and the weight of the shorter consecutive-car test train shall not exceed 0.15%. If the difference in test results exceeds 0.15%, the length of the shorter consecutive-car test train shall be increased until agreement within 0.15% is achieved. Any

adjustments to the weighing system based upon the use of a shorter consecutive-car test train shall be offset to correct the bias that was observed between the full-length train test and the shorter consecutive-car test train.  
(Added 1990; Amended 1992, 1993)

**N.4.3.1.2. Subsequent Verification.** - The test train may consist of either a consecutive-car test train with a length not less than that used in initial verification, or a distributed-car test train representing the number of cars used in the normal operation.  
(Added 1990)

**N.4.3.1.3. Distributed-Car Test Trains.**

- (a) The length of the train shall be typical of trains that are normally weighed.
- (b) The reference weight cars shall be split into three groups, each group consisting of 10 cars or 10 percent of the train length, whichever is less.  
(Amended 1991)

## 2.20. Scales

- (c) The test groups shall be placed near the front, around the middle, and near the end of the train.

(d) Following the final adjustment, the distributed-car test train shall be run over the scale at least three times or shall produce 50 weight values, whichever is greater.

- (e) The weighing system shall be tested in each mode of operation.

(Added 1990; Amended 1992)

### N.4.3.1.4. Consecutive-Car Test Trains.

- (a) A consecutive-car test train shall consist of at least 10 cars.
- (b) If the consecutive-car test train consists of between 10 and 20 cars, inclusive, it shall be run over the scale a minimum of five times in each mode of operation following the final calibration.
- (c) If the consecutive-car test train consists of more than 20 cars, it shall be run over the scale a minimum of three times in each mode of operation.

(Added 1990; Amended 1992)

### N.5. Uncoupled-in-Motion Railroad Weighing System. -

An uncoupled-in-motion scale shall be tested statically before being tested in motion by passing railroad reference weight cars over the scale. When an uncoupled-in-motion railroad weighing system is tested, the car speed and the direction of travel shall be the same as when the scale is in normal use. The minimum in-motion test shall be three reference weight cars passed over the scale three times. The cars shall be selected to cover the range of weights that

are normally weighed on the system and to reflect the types of cars normally weighed.

(Added 1993)

**N.6. Nominal Capacity of Prescription Scales. -** The nominal capacity of a prescription scale shall be assumed to be 1/2 apothecary ounce, unless otherwise marked. (Applicable only to scales not marked with an accuracy class.)

## T. Tolerances Applicable to Devices not Marked I, II, III, III L, or IIII

### T.1. Tolerance Values.

**T.1.1. General. -** The tolerances applicable to devices not marked with an accuracy class shall have the tolerances applied as specified in Table T.1.1. (Amended 1990)

**T.1.2. Postal and Parcel Post Scales. -** The tolerances for postal and parcel post scales are given in Table T.1.1. and Table 5. (Amended 1990)

### T.2. Sensitivity Requirement (SR)

**T.2.1. Application. -** The sensitivity requirement (SR) is applicable to all nonautomatic-indicating scales not marked I, II, III, III L, or IIII, and is the same whether acceptance or maintenance tolerances apply.

**T.2.2. General. -** Except for scales specified in paragraphs T.2.3. through T.2.8.: 2d, 0.2 percent of the scale capacity, or 40 lb, whichever is least.

**T.2.3. Prescription Scales. -** 6 mg (0.1 grain).

Table 5. Maintenance and Acceptance Tolerances for Unmarked Postal and Parcel Post Scales					
Scale Capacity	Test loads	Maintenance tolerance (±)		Acceptance tolerance (±)	
(lb)	(lb)	(oz)	(lb)	(oz)	(lb)
0 to 4, inclusive*	0 to 1, inclusive	1/32	0.002	1/32	0.002
	over 1	1/8	0.008	1/16	0.004
over 4*	0 to 7, inclusive	3/16	0.012	3/16	0.012
	7+ to 24, inclusive	3/8	0.024	3/16	0.012
	24+ to 30, inclusive	1/2	0.030	1/4	0.015
	over 30	0.1% of Test Load		0.05% of Test Load	
*See Table T.1.1. for scales designed and/or used to weigh loads less than 2 lb.					

Table T.1.1. Tolerances for Unmarked Scales

Type of Device	Subcategory	Min. Tol.	Accept. Tol.	Maint. Tol.	Decreasing Load Multiplier <sup>1</sup>	Other Applicable Requirements
Vehicle, axle-load, livestock, railway track (weighing statically), Crane, and hopper (other than grain hopper)		Class III L, T.N.3.1 (Table 6) and T.N.3.2.			1.0	T.N.2., T.N.3., T.N.4.1., T.N.4.2., T.N.4.3., T.N.4.4., T.N.5., T.N.7.2., T.N.8.1.4. <sup>4</sup> , T.N.9.
Grain test scales	n ≤ 10 000 n > 10 000	Class III, T.N.3.1. (Table 6) and T.N.3.2. Class II, T.N.3.1. (Table 6) and T.N.3.2.			1.0	T.N.8.1.4. <sup>4</sup> , T.N.9.
Railway track scales Weighing in motion		T.N.3.6. except that for T.N.3.6.2. (a), no single error shall exceed four times the maintenance tolerance.			1.0	T.N.8.1.4. <sup>4</sup> , T.N.9.
Monorail Scales, In-Motion		T.N.3.8.			1.0	T.N.8.1.4. <sup>4</sup> , T.N.9.
Customer-Operated Bulk-Weighing Systems for Recycled Materials		± 5% of applied material test load. Average error on 10 or more test loads ≤ 2.5%.			1.0	T.N.8.1.4. <sup>4</sup> , T.N.9.
Wheel-load weighers and Portable axle-load Scales	Tested individually or in pairs <sup>2</sup>	0.5d or 50 lb, whichever is greater	1% of test load	2% of test load	1.5 <sup>3</sup>	T.N.8.1.4. <sup>4</sup> , T.N.9.
Prescription scales		0.1 grain (6 mg)	0.1 % of test load load	0.1% of test load	1.5	T.N.8.1.4. <sup>4</sup> , T.N.9.
Jewelers' scales	Graduated	0.5d	0.05% of test load	0.05% of test load	1.5	T.N.8.1.4. <sup>4</sup> , T.N.9.
	Ungraduated	Sensitivity or smallest weight, whichever is less				
Dairy-product-test scale	Loads < 18 g 18 g load	0.2 grain 0.2 grain	0.2 grain 0.3 grain	0.2 grain 0.5 grain	1.5	T.N.8.1.4. <sup>4</sup> , T.N.9.
Postal and parcel post scales Designed/used to weigh loads < 2 lb	Loads < 2 lb	15 grain, 1 g, 1/32 oz, 0.03 oz, or 0.002 lb	15 grain, 1 g, 1/32 oz, 0.03 oz, or 0.002 lb	15 grain, 1 g, 1/32 oz, 0.03 oz, or 0.002 lb	1.5	T.N.8.1.4. <sup>4</sup> , T.N.9.
	Loads ≥ 2 lb	Table 5	Table 5	Table 5		
Other postal and parcel post scales		Table 5	Table 5	Table 5	1.5	T.N.8.1.4. <sup>4</sup> , T.N.9.
All other scales	n > 5 000	0.5d or 0.05% of scale capacity, whichever is less	0.05% of test load	0.1% of test load	1.5	T.N.2.5., T.N.4.1., T.N.4.2., T.N.4.3., T.N.5., T.N.7.2., T.N.8.1.4. <sup>4</sup> , T.N.9.
	n ≤ 5 000	Class III, T.N.3.1., Table 6 and T.N.3.2.			1.0	T.N.2., T.N.3., T.N.4.1., T.N.4.2., T.N.4.3., T.N.5., T.N.7.2., T.N.8.1.4. <sup>4</sup> , T.N.9.

<sup>1</sup> The decreasing load test applies only to automatic indicating scales.<sup>2</sup> If marked and tested as a pair, the tolerance shall be applied to the sum of the indications.<sup>3</sup> The decreasing load test does not apply to portable wheel load weighers.

(Added 1990; Amended 1992 and 1998)

<sup>4</sup> T.N.8.1.4. Operating Temperature is nonretroactive and effective for unmarked devices manufactured after January 1, 1981.



**T.2.4. Jewelers' Scales.**

**T.2.4.1. With One-Half Ounce Capacity or Less.** – 6 mg (0.1 grain).

**T.2.4.2. With More Than One-Half Ounce Capacity.** – 1d or 0.05 percent of the scale capacity, whichever is less.

**T.2.5. Dairy-Product-Test Scales**

**T.2.5.1. Used in Determining Butterfat Content.** – 32 mg (0.5 grain).

**T.2.5.2. Used in Determining Moisture Content.** – 19 mg (0.3 grain).

**T.2.6. Grain Test Scales.** – The sensitivity shall be as stated in T.N.6.  
(Amended 1987)

**T.2.7. Vehicle, Axle-Load, Livestock, and Animal Scales.**

**T.2.7.1. Equipped With Balance Indicators.** – 1d.

**T.2.7.2. Not Equipped With Balance Indicators.** – 2d or 0.2 percent of the scale capacity, whichever is less.

**4002.2. Scales (2.20)**

**(d) Livestock Scales Not Equipped With Balance Indicator.** The Sensitivity Requirement for livestock scales not equipped with a balance indicator shall be 10 pounds, notwithstanding the requirements of Handbook 44, Section 2.20. Scales, T.2.7.2.

**T.2.8. Railway Track Scales.** – 3d or 100 lb, whichever is less.

**T.3. Sensitivity Requirement, Equilibrium Change Required.** The minimum change in equilibrium with test loads equal to the values specified in T.2. shall be as follows:

- (a) Scale With a Trig Loop but Without a Balance Indicator. The position of rest of the weighbeam shall change from the center of the trig loop to the top or bottom, as the case may be.

- (b) Scale With a Single Balance Indicator and Having a Nominal Capacity of Less Than 250 g (500 b). The position of rest of the indicator shall change 1.0 mm (0.04 in) or one division on the graduated scale, whichever is greater.

- (c) Scale With a Single Balance Indicator and Having a Nominal Capacity of 250 kg (500 lb) or Greater. The position of rest of the indicator shall change 6.4 mm (0.25 in) or one division on the graduated scale or the width of the central target area, whichever is greater. However, the indicator on a batching scale shall change 3.2 mm (0.125 in) or one division on the graduated scale, whichever is greater.

- (d) Scale With Two Opposite-Moving Balance Indicators. The position of rest of the two indicators moving in opposite directions shall change 1.0 mm (0.04 in) with respect to each other

- (e) Scale With Neither a Trig Loop Nor a Balance Indicator. The position of rest of the weighbeam or lever system shall change from the horizontal, or midway between limiting stops, to either limit of motion.

## **T.N. Tolerances Applicable to Devices Marked I, II, III, III L, & IIII.**

**T.N.1. Principles.**

**T.N.1.1. Design.** – The tolerance for a weighing device is a performance requirement independent of the design principle used.

**T.N.1.2. Accuracy Classes.** – Weighing devices are divided into accuracy classes according to the number of scale divisions (n) and the value of the scale division (d).

**T.N.1.3. Scale Division.** – The tolerance for a weighing device is related to the value of the scale division (d) or the value of the verification scale division (e) and is generally expressed in terms of d or e.

**T.N.2. Tolerance Application.**

**T.N.2.1. General.** – The tolerance values are positive (+) and negative (-) with the weighing device adjusted to zero at no load. When tare is in use, the tolerance values are applied from the tare zero reference; the tolerance values apply to certified test loads only.

**T.N.2.2. Type Evaluation Examinations.** – For type evaluation examinations, the tolerance values apply to increasing and decreasing load tests within the temperature, power supply, and barometric pressure limits specified in T.N.8.

**T.N.2.3. Subsequent Verification Examinations.** - For subsequent verification examinations, the tolerance values apply regardless of the influence factors in effect at the time of the conduct of the examination. (Also see G-N.2.)

**T.N.2.4. Multi-Interval and Multiple Range (Variable Division-Value) Scales.** - For multi-interval and multiple range scales, the tolerance values are based on the value of the scale division of the range in use. (Amended 2000)

**T.N.2.5. Ratio Tests.** - For ratio tests, the tolerance values are 0.75 of the applicable tolerances.

### **T.N.3. Tolerance Values.**

**T.N.3.1. Maintenance Tolerance Values.** - The maintenance tolerance values are as specified in Table 6.

**T.N.3.2. Acceptance Tolerance Values.** - The acceptance tolerance values shall be one-half the maintenance tolerance values.

**T.N.3.3. Wheel-Load Weighers and Portable Axle-Load Weighers of Class III.** - The tolerance values are two times the values specified in T.N.3.1. and T.N.3.2. (Amended 1986)

**T.N.3.4. Crane and Hopper (Other than Grain Hopper) Scales.** - The maintenance and acceptance tolerances shall be as specified in T.N.3.1. and T.N.3.2. for Class III L, except that the tolerance for crane and construction materials hopper scales shall not be less than 1d or 0.1 percent of the scale capacity, whichever is less. (Amended 1986)

**T.N.3.5. Separate Main Elements: Load Transmitting Element, Indicating Element, Etc.** - If a main element separate from a weighing device is submitted for type evaluation, the tolerance for the element is 0.7 that for the complete weighing device. This fraction includes the tolerance attributable to the testing devices used.

**T.N.3.6. Coupled-In-Motion Railroad Weighing Systems.** - The maintenance and acceptance tolerance values for the group of weight values appropriate to the application must satisfy the following conditions: (Amended 1990 and 1992)

**T.N.3.6.1.** - For any group of weight values, the difference in the sum of the individual in-motion car weights of the group as compared to the sum of the individual static weights shall not exceed 0.2 percent. (Amended 1990)

Table 6. Maintenance Tolerances (All values in this table are in scale divisions)				
Tolerance in Scale Divisions				
	1	2	3	5
Class	Test Load			
I	0 – 50 000	50 001 - 200 000	200 001 +	
II	0 – 5 000	5 001 - 20 000	20 001 +	
III	0 – 500	501 - 2 000	2 001 - 4 000	4 001 +
III	0 – 50	51 - 200	201 - 400	401 +
III L	0 – 500	501 - 1 000	(Add 1d for each additional 500d or fraction thereof)	

**T.N.3.6.2.** - If a weighing system is used to weigh trains of five or more cars, and if the individual car weights are used, any single weight value within the group must meet the following criteria:

- (a) no single error may exceed three times the static maintenance tolerance;
  - (b) not more than 5 percent of the errors may exceed two times the static maintenance tolerance; and
  - (c) not more than 35 percent of the errors may exceed the static maintenance tolerance.
- (Amended 1990 and 1992)

**T.N.3.6.3.** - For any group of weight values wherein the sole purpose is to determine the sum of the group, T.N.3.6.1. alone applies.  
(Amended 1990)

**T.N.3.6.4.** - For a weighing system used to weigh trains of less than five cars, no single car weight within the group may exceed the static maintenance tolerance.  
(Amended 1990 and 1992)

**T.N.3.7. Uncoupled-in-Motion Railroad Weighing Systems.** - The maintenance and acceptance tolerance values for any single weightment within a group of noninteractive (i.e., uncoupled) loads, the weightment error shall not exceed the static maintenance tolerance.  
(Amended 1992)

**T.N.3.8. Dynamic Monorail Weighing System.** - Acceptance tolerance shall be the same as the maintenance tolerance shown in Table 6. On a dynamic test of 20 or more individual test loads, 10 percent of the individual test loads may be in error, each not to exceed two times the tolerance. The error on the total of the individual test loads shall not exceed  $\pm 0.2$  percent. (See also Note in N.1.3.6.1.) *For equipment undergoing type evaluation, a tolerance equal to one-half the maintenance tolerance values shown in Table 6 shall apply.*  
[Nonretroactive January 1, 2002]  
(Added 1986) (Amended 1999 and 2001)

**T.N.3.9. Materials Test on Customer-Operated Bulk Weighing Systems for Recycled Materials.** - The maintenance and acceptance tolerance shall be  $\pm 5$  percent of the applied materials test load except that the average error on 10 or more test materials test loads shall not exceed  $\pm 2.5$  percent.  
(Added 1986)

**T.N.3.10. Prescription Scales with a Counting Feature.** In addition to Table 6 Maintenance Tolerances (for weight), the indicated piece count value computed by a Class I or Class II prescription scale counting feature shall comply with the tolerances in Table T.N.3.10.

<b>Table T.N.3.10. Maintenance and Acceptance Tolerances in Excess and in Deficiency for Count</b>	
Indication of Count	Tolerance (piece count)
0 to 100	0
101 to 200	1
201 or more	0.5%

(Added 2003)

**T.N.3.11. Tolerances for Substitution Test.** - Tolerances are applied to the scale based on the substitution test load.  
(Added 2003)

**T.N.3.12. Tolerances for Strain-Load Test.** - Tolerances apply only to the test weights or substitution test loads.  
(Added 2003)

#### **T.N.4. Agreement of Indications.**

**T.N.4.1. Multiple Indicating/Recording Elements.** - In the case of a scale or weighing system equipped with more than one indicating element or indicating element and recording element combination, where the indicators or indicator/recorder combination are intended to be used independently of one another, tolerances shall be applied independently to each indicator or indicator/recorder combination.  
(Amended 1986)

**T.N.4.2. Single Indicating/Recording Element.** - In the case of a scale or weighing system with a single indicating element or an indicating/recording element combination and equipped with component parts such as unit weights, weighbeam and weights, or multiple weighbeams that can be used in combination to indicate a weight, the difference in the weight value indications of any load shall not be greater than the absolute value of the applicable tolerance for that load, and shall be within tolerance limits.  
(Amended 1986)

**T.N.4.3. Single Indicating Element/Multiple Indications.** - In the case of an analog indicating element equipped with two or more indicating means within the same element, the difference in the weight indications for any load other than zero shall not be greater than one-half the value of the scale division (d) and be within tolerance limits.  
(Amended 1986)

**UR.1.2. Grain Hopper Scales.** - The minimum number of scale divisions for a Class III Hopper Scale used for weighing grain shall be 2 000.

**UR.1.3. Value of the Indicated and Recorded Scale Division.** - *The value of the scale division as recorded shall be the same as the division value indicated.*

*[Nonretroactive as of January 1, 1986]*

(Added 1985) (Amended 1999)

**UR.1.3.1. Exceptions.** – The provisions of UR.1.3. Value of the Indicated and Recorded Scale Division shall not apply to:

- (a) Class I scales, or
  - (b) Dynamic monorail weighing systems when the value of d is less than the value of e.
- (Added 1999)

**UR.1.4. Grain-Test Scales: Value of the Scale Divisions.** - The scale division for grain-test scales shall not exceed 0.2 g for loads through 500 g, and shall not exceed 1 g for loads above 500 g through 1 000 g.

(Added 1992)

**UR.1.5. Recording Element, Class III L Railway Track Scales.** - *Class III L Railway Track Scales must be equipped with a recording element.*

*[Nonretroactive as of January 1, 1996.]*

(Added 1995)

## **UR.2. Installation Requirements.**

**UR.2.1. Supports.** - A scale that is portable and that is being used on a counter, table, or the floor shall be so positioned that it is firmly and securely supported.

**UR.2.2. Suspension of Hanging Scale.** - A hanging scale shall be freely suspended from a fixed support when in use.

**UR.2.3. Protection From Environmental Factors.** - The indicating elements, the lever system or load cells, and the load-receiving element of a permanently installed scale, and the indicating elements of a scale not intended to be permanently installed, shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the device.

**UR.2.4. Foundation, Supports, and Clearance.** - The foundation and supports of any scale installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the load-receiving element is empty, nor throughout the weighing range of the scale. *On vehicle and livestock scales, the clearance between the load-receiving elements and the coping at the bottom edge of the platform shall be greater than at the top edge of the platform.*

*[Nonretroactive as of January 1, 1973.]*

**UR.2.5. Access to Weighing Elements.** - Adequate provision shall be made for ready access to the pit of a vehicle, livestock, animal, axle-load, or railway track scale for the purpose of inspection and maintenance. Any of these scales without a pit shall be installed with adequate means for inspection and maintenance of the weighing elements.

(Amended 1985)

## **UR.2.6. Approaches.**

### **UR.2.6.1. Vehicle Scales.**

**[NOT ADOPTED]**

**UR.2.6.2. Axle-Load Scales.** - At each end of an axle-load scale there shall be a straight paved approach in the same plane as the platform. The approaches shall be the same width as the platform and of sufficient length to insure the level positioning of vehicles during weight determinations.

**UR.2.7. Stock Racks.** - A livestock or animal scale shall be equipped with a suitable stock rack, with gates as required, which shall be securely mounted on the scale platform. Adequate clearances shall be maintained around the outside of the rack.

**UR.2.8. Hoists.** - On vehicle scales equipped with means for raising the load-receiving element from the weighing element for vehicle unloading, means shall be provided so that it is readily apparent to the scale operator when the load receiving element is in its designed weighing position.

**UR.2.9. Provision for Testing Dynamic Monorail Weighing Systems.** - Provisions shall be made at the time of installation of a dynamic monorail weighing systems for testing in accordance with N.1.3.6.1. (a rail around or other means for returning the test carcasses to the scale being tested).

*[Nonretroactive as of January 1, 1998]*

(Added 1997) (Amended 1999)

**UR.3. Use Requirements.**

**UR.3.1. Recommended Minimum Load.** - A recommended minimum load is specified in Table 8 since the use of a device to weigh light loads is likely to result in relatively large errors.

**UR.3.1.1. Minimum Load, Grain Dockage Determination.** - When determining the quantity of foreign material (dockage) in grain, the weight of the sample shall be equal to or greater than 500 scale divisions.

(Added 1985)

**UR.3.2. Maximum Load.** - A scale shall not be used to weigh a load of more than the nominal capacity of the scale.

**UR.3.2.1. Maximum Loading for Vehicle Scales.** - A vehicle scale shall not be used to weigh loads exceeding the maximum load capacity of its span as specified in Table UR.3.2.1.

(Added 1996)

**UR.3.3. Single-Draft Vehicle Weighing.** - A vehicle or a coupled vehicle combination shall be commercially weighed on a vehicle scale only as a single draft. That is, the total weight of such a vehicle or combination shall not be determined by adding together the results obtained by separately and not simultaneously weighing each end of such vehicle or individual elements of such coupled combination. However:

- (a) the weight of a coupled combination may be determined by uncoupling the various elements (tractor, semitrailer, trailer), weighing each unit separately as a single draft, and adding together the results, or
- (b) the weight of a vehicle or coupled-vehicle combination may be determined by adding together the weights obtained while all individual elements are resting simultaneously on more than one scale platform.

[Note: This paragraph does not apply to highway-law-enforcement scales and scales used for the collection of statistical data.]

(Added 1992)

Table 8. Recommended Minimum Load		
Class	Value of scale division (d or e*)	Recommended minimum load (d or e*)
I	equal to or greater than 0.001 g	100
II	0.001 to 0.05 g, inclusive	20
	equal to or greater than 0.1 g	7 50
III	All**	20
III L	All	50
III	All	10
<p>* For Class I and II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape or color), the value of the verification scale division "e" is the value of the scale division immediately preceding the auxiliary means. For Class III and III devices the value of "e" is specified by the manufacturer as marked on the device; "e" must be less than or equal to "d."</p> <p>** A minimum load of 10d is recommended for a weight classifier marked in accordance with a statement identifying its use for special applications.</p>		

(Amended 1990)

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## Sec. 2.22. Automatic Bulk Weighing Systems<sup>1</sup>

### A. Application

**A.1. General.** - This code applies to automatic bulk weighing systems, that is, weighing systems adapted to the automatic weighing of a commodity in successive drafts of predetermined amounts automatically recording the no-load and loaded weight values and accumulating the net weight of each draft.  
(Amended 1987)

**A.2.** Also see General Code requirements.

### S. Specifications

#### S.1. Design of Indicating and Recording Elements and Recorded Representations.

**S.1.1. Zero Indication.** - Provisions shall be made to indicate and record a no-load reference value and, if the no-load reference value is a zero value indication, to indicate and record an out-of-balance condition on both sides of zero.

**S.1.1.1. Digital Zero Indication.** - A digital zero indication shall represent a balance condition that is within  $\pm 1/2$  the value of the scale division.

**S.1.2. Value of Scale Division (d).** - *The value of the scale division (d), expressed in a unit of weight, shall be equal to:*

- (a) 1, 2, or 5; or
- (b) a decimal multiple or submultiple of 1, 2, or 5; or
- (c) a binary submultiple of a unit of weight.

*Examples: Scale divisions may be 0.01, 0.02, or 0.05; 0.1, 0.2, or 0.5; 1, 2, or 5; 10, 20, or 50; or 1/2, 1/4, 1/8, 1/16, etc.*

*[Nonretroactive as of January 1, 1986.]*

(Amended 1987)

**S.1.3. Capacity Indication and Recorded Representation.** An indicating or recording element shall not indicate or record any values when the gross load is in excess of 105 percent of the capacity of the system.

**S.1.4. Weighing Sequence.** - For systems used to receive (weigh in), the no-load reference value shall be determined

and recorded only at the beginning of each weighing cycle. For systems used to deliver (weigh out), the no-load reference value shall be determined and recorded only after the gross load reference value for each weighing cycle has been indicated and recorded.

**S.1.5. Recording Sequence.** - Provision shall be made so that all weight values are indicated until the completion of the recording of the indicated value.

**S.1.6. Provision for Sealing Adjustable Components on Electronic Devices.** - Provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of the device.

#### S.2. Design of Balance and Damping Mechanism.

**S.2.1. Zero-Load Adjustment.** - The weighing system shall be equipped with manual or semiautomatic means by which the zero-load balance or no-load reference value indication may be adjusted. An automatic zero-tracking mechanism is prohibited.

**S.2.1.1. Manual.** - A manual zero-load or no-load reference value setting mechanism shall be operable or accessible only by a tool outside of or entirely separate from this mechanism or enclosed in a cabinet.

**S.2.1.2. Semiautomatic.** - A semiautomatic zero-load or no-load reference value setting mechanism shall meet the provisions of S.2.1.1. or shall be operable only when:

- (a) the indication is stable within  $\pm 3$  scale divisions, and
- (b) cannot be operated during a weighing operation.

**S.2.2. Damping Means.** - A system shall be equipped with effective means necessary to bring the indications quickly to a readable, stable equilibrium. Effective means shall also be provided to permit the recording of weight values only when the indication is stable within plus or minus three scale divisions for devices with 10 000 scale divisions, or plus or minus one division for devices with less than 10 000 scale divisions.

<sup>1</sup>(Title amended 1986)



## 2.22. Automatic Bulk Weighing Systems

### S.3. Interlocks and Gate Control.

**S.3.1. Gate Position.** - Provision shall be made to clearly indicate to the operator the position of the gates leading directly to and from the weigh hopper.

**S.3.2. Interlocks.** - Each automatic bulk weighing system shall have operating interlocks to provide for the following:

- (a) Product cannot be cycled and weighed if the weight recording element is disconnected or subjected to a power loss.
- (b) The recording element cannot print a weight if either of the gates leading directly to or from the weigh hopper is open.
- (c) A "low paper" sensor, when provided, is activated.
- (d) The system will operate only in the proper sequence in all modes of operation.
- (e) When an overfill alarm is activated, the system shall indicate and record an overfill condition.  
(Amended 1993)

#### S.3.3. Overfill Sensor.

- (a) The weigh hopper shall be equipped with an overfill sensor which will cause the feed gate to close, activate an alarm, and inhibit weighing until the overfill condition has been corrected.

(Part (a) Added 1993) (Amended 1997)

- (b) *If the system is equipped with a lower garner or surge bin, that garner shall also be equipped with an overfill sensor which will cause the gate of the weigh hopper to remain open, activate an alarm, and inhibit weighing until the overfill condition has been corrected.*

*[Nonretroactive as of January 1, 1998]*

(Part (b) Amended 1997)

### S.4. Design of Weighing Elements.

**S.4.1. Antifriction Means.** - At all points at which a live part of the mechanism may come into contact with another part in the course of normal usage, frictional effects shall be reduced to a minimum by means of suitable antifriction means, opposing surfaces and points being properly shaped, finished, and hardened.

**S.4.2. Adjustable Components.** - An adjustable component, such as a potentiometer, shall be held securely in adjustment and, except for a component for adjusting level

or a no-load reference value, shall not be adjustable from the outside of the device.

**S.4.3. Multiple Load-Receiving Elements.** - A system with a single indicating or recording element, or a combination indicating recording element, that is coupled to two or more load-receiving elements with independent weighing systems, shall be provided with means to prohibit the activation of any load-receiving element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which load-receiving element (or elements) is in use.

**S.4.4. Venting.** - All weighing systems shall be vented so that any internal or external pressure will not affect the accuracy or operation of the system.

### S.5. Marking Requirements. (See also G-S.1.)

**S.5.1. Capacity and Value of the Scale Division.** - The capacity of the weighing system and the value of the scale division shall be clearly and conspicuously marked on the indicating element near the weight value indications.

**S.5.2. Weighing Elements.** - On a weighing element not permanently attached to an indicating element, there shall be clearly and permanently marked for the purposes of identification, the name, initials, or trademark of the manufacturer, the manufacturer's designation that positively identifies the pattern or design, and the nominal capacity.

**S.5.3. Temperature Limits.** - *Unless the temperature range is -10 °C to +40 °C (14 °F to 104 °F), the temperature range shall be marked on the device.*

*[Nonretroactive as of January 1, 1986.]*

(Added 1985)

#### S.5.4. Accuracy Class.

- (a) *All systems used to weigh grain shall be marked Class III\*.*

- (b) *All other systems shall be marked either Class III or III L\*.*

*(\*See Section 2.20. Scales Code for the parameters for these accuracy classes for scales. The specific requirements for automatic bulk weighing systems apply to these devices when there is a conflict between the Scales Code and the Automatic Bulk Weighing Systems Code.)*

*[Nonretroactive as of January 1, 1986.]*

(Added 1985; Amended 1992)

- (b) **For Automatic Checkweighers.** Security seals are not required in applications where it would prohibit an authorized user from having access to the calibration functions of a device.  
(Amended 2004)

**S.1.4. Automatic Calibration.** A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

**S.1.5. Adjustable Components.** Adjustable components shall be held securely in adjustment and, except for a zero-load balance mechanism, shall be located within the housing of the element.  
(Amended 2004)

## S.2. Design of Zero and Tare Mechanisms.

### S.2.1. Zero Load Adjustment.

**S.2.1.1. Automatic Zero-Tracking Mechanism.** Except for automatic checkweighers, under normal operating conditions the maximum load that can be “rezeroed,” when either placed on or removed from the platform all at once, shall be 1.0 scale division.  
(Amended 2004)

**S.2.1.2. Initial Zero-Setting Mechanism.** Except for automatic checkweighers, an initial zero-setting mechanism shall not zero a load in excess of 20% of the maximum capacity of the automatic weighing system unless tests show that the scale meets all applicable tolerances for any amount of initial load compensated by this device within the specified range.

**S.2.2. Tare.** On any automatic weighing system, the value of the tare division shall be equal to the value of the division. The tare mechanism shall operate only in a backward direction (i.e., in a direction of under-registration) with respect to the zero-load balance condition of the automatic weighing system. A device designed to automatically clear any tare value shall also be designed to prevent the automatic clearing of tare until a complete transaction has been indicated.

**Note:** On a computing automatic weighing system, this requires the input of a unit price, the display of the unit price, and a computed positive total price at a readable equilibrium. Other devices require that a transaction or lot run be completed.  
(Amended 2004)

## S.3. Verification Scale Interval.

**S.3.1. Multiple Range and Multi-Interval Automatic Weighing System.** The value of “e” shall be equal to the value of “d.”

**S.3.2. Load Cell Verification Interval Value.** The relationship of the value for the load cell verification scale interval,  $v_{\min}$ , to the scale division,  $d$ , for a specific scale installation shall be:

$$v_{\min} \leq \frac{d}{\sqrt{N}}$$

where  $N$  is the number of load cells in the scale.

**Note:** When the value of the scale division,  $d$ , differs from the verification scale division,  $e$ , for the scale, the value of  $e$  must be used in the formula above.

**S.3.3.** For automatic checkweighers, the value of “e” shall be specified by the manufacturer and may be larger than “d,” but in no case can “e” be more than 10 times the value of “d.”

## S.4. Weight Indicators, Weight Displays, Reports, and Labels.

**S.4.1. Additional Digits in Displays.** Auxiliary digital displays that provide additional digits for use during performance evaluation may be included on automatic checkweighers. However, in cases where these indications are not valid for determining the actual weight of a package (e.g., only appropriate for use in statistical process control programs by users) they shall be clearly and distinctly differentiated from valid weight displays by indicating them to the user.  
(Amended 2004)

For example, the additional digits may be differentiated by color, partially covered by placing crosshatch overlays on the display, or made visible only after the operator presses a button or turns a key to set the device in a mode which enables the additional digits.

**S.4.2. Damping.** An indicating element equipped with other than automatic recording elements shall be equipped with effective means to permit the recording of weight values only when the indication is stable within plus or minus one scale division. The values recorded shall be within applicable tolerances.  
(Amended 2004)

**S.4.3. Over Capacity Indication.** An indicating or recording element shall not display nor record any values when the scale capacity is exceeded by nine scale divisions.  
(Amended 2004)

## 2.24. Automatic Weighing Systems

**S.4.4. Label Printer.** A device that produces a printed ticket to be used as the label for a package shall print all values digitally and of such size, style of type, and color as to be clear and conspicuous on the label.  
(Amended 2004)

**S.4.4.1. Label Printing.** If an automatic check-weigher prints a label containing weight information that will be used in a commercial transaction, it must conform to all of the requirements specified for weigh-labelers so that the printed ticket meets appropriate requirements.  
(Amended 2004)

### S.5. Accuracy Class.

**S.5.1. Marking.** Weigh-labelers and automatic check-weighers shall be Class III devices and shall be marked accordingly, except that a weigh-labeler marked Class IIIS may be used in package shipping applications.  
(Amended 1997)

**S.6. Parameters for Accuracy Classes.** The number of divisions for device capacity is designated by the manufacturer and shall comply with parameters shown in Table S.6.

**S.7. Marking Requirements.** [See also G-S.1., G-S.4., G-S.6., G-S.7., G-U.2.1.1., and UR.3.3.]

**S.7.1. Location of Marking Information.** Automatic weighing systems which are not permanently attached to an indicating element, and for which the load-receiving element is the only part of the weighing/load-receiving element visible after installation, may have the marking information required in G-S.1. of the General Code and Table S.7.a. and S.7.b. of the Automatic Weighing System Code located in an area that is accessible only through the use of a tool; provided that the information is easily accessible (e.g., the information may appear on the junction box under an access plate). The identification information for these automatic weighing systems shall be located on the weighbridge (load-receiving element) near the point where the signal leaves the weighing element or beneath the nearest access cover.

**S.7.2. Marking Required on Components of Automatic Weighing Systems.** The following components of automatic weighing systems shall be marked as specified in Tables S.7.a. and S.7.b.:

- (a) Main elements and components when not contained in a single enclosure for the entire automatic weighing system;
- (b) Load cells for which Certificates of Conformance (CC) have been issued under the National Type Evaluation Program; and
- (c) Other equipment necessary to a weighing system, but having no metrological effect on the weighing system.  
(Amended 2004)

Table S-6. Parameters for Accuracy Classes			
		Number of divisions (n)	
Class	Value of the verification division (e)	Minimum	Maximum
SI Units			
III	0.1 to 2 g inclusive	100	10 000
	equal to or greater than 5 g	500	10 000
INCH-POUND Units			
III	0.0002 lb to 0.005 lb, inclusive	100	10 000
	0.005 oz to 0.125 oz, inclusive	100	10 000
	equal to or greater than 0.01 lb	500	10 000
	equal to or greater than 0.25 oz	500	10 000
IIIS	greater than 0.01 lb	100	1000
	greater than 0.25 oz	100	1000
For Class III devices, the value of “e” is specified by the manufacturer as marked on the device; “d” shall not be smaller than 0.1 “e.” “e” shall be differentiated from “d” by size, shape, or color.			

(Amended 1997 and 2004)

Table S.7.a. Marking Requirements						
To Be Marked With	Weighing Equipment	Weighing, load-receiving, and indicating element in same housing	Indicating element not permanently attached to weighing and load-receiving element	Weighing and load-receiving element not permanently attached to indicating element	Load cell with CC (11)	Other equipment or device (10)
Manufacturer's ID	(1)	X	X	X	X	
Model Designation	(1)	X	X	X	X	
Serial Number and Prefix	(2)	X	X	X	X	
Certificate of Conformance Number	(16)	X	X	X	X	X(16)
Accuracy Class	(14)	X	X(8)	X	X	X
Nominal Capacity	(3)(15)	X	X	X		X
Value of Division, d	(3)	X	X			X(13)
Value of “e”	(4)	X	X			
Temperature Limits	(5)	X	X	X	X	
Special Application	(11)	X	X	X		
Maximum Number of Scale Divisions $n_{\max}$	(6)		X(8)	X	X	
Minimum Verification Division ( $e_{\min}$ )				X		
“S” or “M”	(7)				X	
Direction of Loading	(12)				X	
Minimum Dead Load					X	
Maximum Capacity (Max)		X			X	
Minimum Capacity (Min)		X				
Safe Load Limit					X	
Load Cell Verification Interval ( $v_{\min}$ )					X	
Maximum Belt Speed (m/sec or m/min)		X		X		

**Note:** See Table S.7.b. for applicable notes.  
(Amended 1999 and 2002)

## 2.24. Automatic Weighing Systems

**Table S.7.b.**  
**Notes for Table S.7.a.**

1. Manufacturer's identification and model designation. (See G-S.1.)	10. The markings may be either on the load cell or in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document. The manufacturer's name or trademark, the model designation, and identifying symbol for the serial number shall also be marked both on the load cell and in any accompanying document.
2. Serial number and prefix. (See G-S.1.)	
3. The nominal capacity and value of the automatic weighing system division shall be shown together (e.g., 50 000 x 5 kg, or 30 x 0.01 lb) adjacent to the weight display when the nominal capacity and value of the automatic weighing system division are not immediately apparent. Each division value or weight unit shall be marked on variable-division value or division-unit automatic weighing systems.	11. An automatic weighing system designed for a special application rather than general use shall be conspicuously marked with suitable words visible to the operator and customer restricting its use to that application.
4. Required only if different from "d."	12. Required if the direction of loading the load cell is not obvious.
5. Required only on automatic weighing systems if the temperature range on the NTEP CC is narrower than and within -10 °C to 40 °C (14 °F to 104 °F). (Amended 2007)	13. Serial number and prefix (See G-S.1) modules without "intelligence" on a modular system (e.g., printer, keyboard module, cash drawer, and secondary display in a point-of-sale system) are not required to have serial numbers.
6. This value may be stated on load cells in units of 1000 (e.g., n: 10 is 10 000 divisions).	14. The accuracy Class of a device shall be marked on the device with the appropriate designation.
7. Denotes compliance for single or multiple load cell applications.	15. The nominal capacity shall be conspicuously marked on any automatic-indicating or recording automatic weighing system so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent.
8. An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class III, and the maximum number of divisions, $n_{max}$ .	
9. Necessary to the weighing system but having no metrological effect, e.g., auxiliary remote display, keyboard, etc.	16. Required only if a CC has been issued for the equipment.

## N. Notes

### N.1. Test Requirements for Automatic Weighing Systems.

#### N.1.1. Test Pucks and Packages.

- (a) Test pucks and packages shall be:
- (1) representative of the type, size, and weight ranges to be weighed on a device, and
  - (2) stable while in motion, hence the length and width of a puck or package should be greater than its height.
- (b) For type evaluation the manufacturer shall supply the test pucks or packages for each range of test loads.  
(Amended 1997 and 2006)

**N.1.2. Accuracy of Test Pucks or Packages.** The error in any test puck or package shall not exceed one-fourth (1/4) of the acceptance tolerance. If packages are used to conduct field tests on automatic weighing systems, the package weights shall be determined on a reference scale or balance with an inaccuracy that does not exceed one-fifth (1/5) of the smallest tolerance that can be applied to the device under test.

**N.1.3. Verification (Testing) Standards.** Field standard weights shall comply with requirements of NIST Handbook 105-1 (Class F) or the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied).  
(Amended 2004)

**N.1.4. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility, Field Evaluation.** An RFI test shall be conducted at a given installation when the presence of RFI has been verified and characterized if those conditions are considered “usual and customary”.  
(Added 2004)

**N.1.5. Tests Loads.** A performance test shall consist of four separate test runs conducted at different test loads according to Table N.1.5.1  
(Amended 2004)

**Table N.1.5. Test Loads**

At or near minimum capacity
At or near maximum capacity
At two (2) critical points between minimum and maximum capacity
Test may be conducted at other loads if the device is intended for use at other specific capacities

(Amended 2004)

**N.1.6. Influence Factor Testing.** Influence factor testing shall be conducted statically.  
(Amended 2004).

**N.2. Test Procedures – Weigh-Labelers.** If the device is designed for use in a non-automatic weighing mode, it shall be tested in the non-automatic mode according to Handbook 44 Section 2.20 Scales Code..

**Note:** If the device is designed for only automatic weighing, it shall only be tested in the automatic weighing mode.  
(Amended 2004)

#### N.2.1. Non-Automatic Tests.

**N.2.1.1. Increasing-Load Test.** The increasing-load test shall be conducted with the test loads approximately centered on the load-receiving element of the scale.

**N.2.1.2. Decreasing-Load Test.** The decreasing-load test shall be conducted with the test loads approximately centered on the load-receiving element of the scale.

**N.2.1.3. Shift Test.** To determine the effect of off-center loading, a test load equal to one-half (1/2) maximum capacity shall be placed in the center of each of the four points equidistant between the center and front, left, back and right edges of the load receiver.

**N.2.1.4. Discrimination Test.** A discrimination test shall be conducted with the weighing device in equilibrium at zero load and at maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained. This test is conducted from just below the lower edge of the zone of uncertainty for increasing load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

## 2.24. Automatic Weighing Systems

**N.2.1.5. Zero-Load Balance Change.** A zero-load balance change test shall be conducted on all automatic weighing systems after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (Also see G-UR.4.2.)

(Amended 2004)

### N.2.2. Automatic Test Procedures.

**N.2.2.1. Tests Non-Automatic.** If the automatic weighing system is designed to operate non-automatically, and is used in that manner, during normal use operation, it shall be tested non-automatically using mass standards. The device shall not be tested non-automatically if it is used only in the automatic mode.

**N.2.2.2. Automatic Tests.** The device shall be tested at the normal operating speed using packages. Test runs should be conducted using at least two test loads distributed over its normal weighing range (e.g., near the lowest and highest ranges in which the device is typically operated). Each test load should be run a minimum of 10 consecutive times.

(Amended 2004)

### N.3. Test Procedures - Automatic Checkweigher.

**N.3.1. Tests Non-Automatic.** If the scale is designed to operate non-automatically during normal user operation, it shall be tested non-automatically according to paragraphs N.2.1.1. Increasing Load Test through N.2.1.5. Zero-Balance Change.

**N.3.2. Automatic Tests.** The device shall be tested at the highest speed in each weight range using standardized test pucks or packages. Test runs shall be conducted using two test loads. The number of consecutive test weighments shall be as specified in Table N.3.2.

(Amended 2004)

**Table N.3.2. Number of Sample Weights Per Test for Automatic Checkweighers**

Weighing Range m = mass of test load	Number of sample weights per test	
	Field	Type Evaluation
20 divisions $\leq m \leq 10$ kg 20 divisions $\leq m \leq 22$ lb	30	60
10 kg $< m \leq 25$ kg 22 lb $< m \leq 55$ lb	16	32
25 kg $< m \leq 100$ kg 55 lb $< m \leq 220$ lb	10	20
100 kg (220 lb) $< m$	10	10

(Amended 2004)

## T. Tolerances

### T.1. Principles.

**T.1.1. Design.** The tolerance for a weighing device is a performance requirement independent of the design principle used.

**T.1.2. Scale Division.** The tolerance for a weighing device is related to the value of the scale division (d) or the value of the verification scale division (e) and is generally expressed in terms of d or e. The random tolerance for automatic checkweighers is expressed in terms of Maximum Allowable Variance (MAV).

### T.2. Tolerance Application.

**T.2.1. General.** The tolerance values are positive (+) and negative (-) with the weighing device adjusted to zero at no load. When tare is in use, the tolerance values are applied from the tare zero reference; the tolerance values apply to certified test loads only.

**T.2.2. Type Evaluation Examinations.** For type evaluation examinations, the tolerance values apply to increasing and decreasing load tests within the temperature, and power supply limits specified in T.7. Influence Factors.  
(Amended 2004)

**T.2.3. Subsequent Verification Examinations.** For type evaluation examinations, the tolerance values apply regardless of the influence factors in effect at the time of the conduct of the examination. (Also see G-N.2., Testing with Nonassociated Equipment)  
(Added 2007)

**T.2.4. Multiple Range and Multi-Interval Automatic Weighing System.** For multiple range and multi-interval devices, the tolerance values are based on the value of the scale division of the range in use.

## Sec. 3.30. Liquid-Measuring Devices

### A. Application

**A.1.** - This code applies to:

- (a) devices used for the measurement of liquids, including liquid fuels and lubricants, and
- (b) wholesale devices used for the measurement and delivery of agri-chemical liquids such as fertilizers, feeds, herbi-cides, pesticides, insecticides, fungicides, and defoliants.  
(Added 1985)

**A.2.** - This code does not apply to:

- (a) meters mounted on vehicle tanks (see Sec. 3.31. Code for Vehicle-Tank Meters),
- (b) devices used for dispensing liquefied petroleum gases (see Sec. 3.32. Code for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices),
- (c) devices used for dispensing other liquids that do not remain in a liquid state at atmospheric pressures and temperatures,
- (d) water meters, or
- (e) devices used solely for dispensing a product in connection with operations in which the amount dispensed does not affect customer charges,
- (f) mass flow meters (see Sec. 3.37. Code for Mass Flow Meters).  
(Added 1994)

**A.3.** - In addition to the requirements of this code, liquid-measuring devices shall meet the requirements of Section 1.10. General Code.

### S. Specifications

#### S.1. Indicating and Recording Elements and Recorded Representations.

**S.1.1. General.** - A liquid-measuring device:

- (a) shall be equipped with a primary indicating element, and
- (b) may be equipped with a primary recording element.

**S.1.2. Units.** - A liquid-measuring device shall indicate, and record if the device is equipped to record, its deliveries in liters, gallons, quarts, pints, fluid ounces, or binary-submultiples or decimal subdivisions of the liter or gallon.

(Amended 1987, 1994 and 2006)

**S.1.2.1. Retail Motor-Fuel Devices.** - Deliveries shall be indicated and recorded, if the device is equipped to record, in liters or gallons and decimal subdivisions or fractional equivalents thereof.

(Added 1979)

#### S.1.2.2. Agri-Chemical Liquid Devices.

**S.1.2.2.1. Liquid Measure.** - Deliveries shall be indicated and recorded in liters or gallons and decimal subdivisions or fractional equivalents thereof.

**S.1.2.3. Value of Smallest Unit.** - The value of the smallest unit of indicated delivery, and recorded delivery if the device is equipped to record, shall not exceed the equivalent of:

- (a) 0.5 L (0.1 gal) on devices with a maximum rated flow rate of 750 L/min (200 gal/min) or less;
- (b) 5 L (1 gal) on devices with a maximum rated flow of more than 750 L/min (200 gal/min);
- (c) 5 L (1 gal) on meters with a rated maximum flow rate of 375 L/min (100 gal/min) or more used for jet fuel aviation refueling systems

(Added 2007)

This requirement does not apply to manually operated devices equipped with stops or stroke-limiting means.

(Amended 1983, 1986, and 2007)

**S.1.3. Advancement of Indicating and Recording Elements.** - It shall not be possible to advance primary indicating and recording elements except by the mechanical operation of the device. Clearing a device by advancing its elements to zero is permitted, but only if:

- (a) once started, the advancement movement cannot be stopped until zero is reached, and
- (b) in the case of indicating elements only, such elements are automatically obscured until the elements reach the correct zero position.



### 3.30. Liquid-Measuring Devices

#### S.1.4. Graduations.

**S.1.4.1. Length.** - Graduations shall be varied in length so that they may be conveniently read.

**S.1.4.2. Width.** - In a series of graduations, the width of:

- (a) every graduation shall be at least 0.2 mm (0.008 in) but not greater than the minimum clear interval between graduations, and
- (b) main graduations shall be not more than 50 percent greater than the width of subordinate graduations.

**S.1.4.3. Clear Interval Between Graduations.** - The clear interval between graduations shall be not less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

- (a) along the line of movement of the tip of the index of the indicator as it passes over the graduations, or
- (b) if the indicator extends over the entire length of the graduations, at the point of widest separation of the graduations.

#### S.1.5. Indicators.

**S.1.5.1. Symmetry.** - The portion of the index of an indicator associated with the graduations shall be symmetrical with respect to the graduations.

#### S.1.5.2. Length.

- (a) If the indicator and the graduations are in different planes, the index of the indicator shall extend to each graduation with which it is to be used.
- (b) If the indicator is in the same plane as the graduations, the distance between the index of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

#### S.1.5.3. Width.

- (a) *The index of an indicator shall not be wider than the width of the narrowest graduation.*  
[Nonretroactive as of January 1, 2002]  
(Amended 2000)
- (b) If the index of an indicator extends over the entire length of a graduation, it shall be of uniform width throughout the portion that coincides with the graduation.

**S.1.5.4. Clearance.** - If the indicator and the

graduations are in different planes, the clearance between the index of an indicator and the plane of the graduations shall be no greater than 1.5 mm (0.06 in).

**S.1.5.5. Parallax.** - Parallax effects shall be reduced to the practical minimum.

#### S.1.6. Additional Operating Requirements, Retail Devices (Except Slow Flow Meters). (Amended 2006)

**S.1.6.1. Indication of Delivery.** - The device shall automatically show on its face the initial zero condition and the quantity delivered (up to the nominal capacity). However, the following requirements shall apply:

For electronic devices manufactured prior to January 1, 2006, the first 0.03 L (or 0.009 gal) of a delivery and its associated total sales price need not be indicated.

*For electronic devices manufactured on or after January 1, 2006, the measurement, indication of delivered quantity, and the indication of total sales price shall be inhibited until the fueling position reaches conditions necessary to ensure that the delivery starts at zero.*

*[Nonretroactive as of January 1, 2006]*

(Added 2005)

(Amended 1982 and 2005)

#### S.1.6.2. Provisions for Power Loss.

**S.1.6.2.1. Transaction Information.** - *In the event of a power loss, the information needed to complete any transaction in progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable for at least 15 minutes at the dispenser or at the console if the console is accessible to the customer.*

*[Nonretroactive as of January 1, 1983.]*

**S.1.6.2.2. User Information.** - *The device memory shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.*

*[Nonretroactive as of January 1, 1983.]*

#### S.1.6.3. Return to Zero.

- (a) The primary indicating elements, and primary recording elements if the device is equipped to record, shall be readily returnable to a definite zero indication. However, a key-lock operated or other self-operated device may be equipped with cumulative indicating or recording elements, provided that it is also equipped with a zero-return indicating element.

- (b) It shall not be possible to return primary indicating elements, or primary recording elements beyond the correct zero position.  
(Amended 1972)

#### S.1.6.4. Display of Unit Price and Product Identity.

##### S.1.6.4.1. Unit Price.

- (a) A computing or money-operated device shall be able to display on each face the unit price at which the device is set to compute or to dispense.
- (b) *Whenever a grade, brand, blend, or mixture is offered for sale from a device at more than one unit price, then all of the unit prices at which that product is offered for sale shall be displayed or shall be capable of being displayed on the dispenser using controls available to the customer prior to the delivery of the product. It is not necessary that all of the unit prices for all grades, brands, blends, or mixtures be simultaneously displayed prior to the delivery of the product. This subsection shall not apply to fleet sales, other contract sales, or truck refueling sales (e.g., sales from dispensers used to refuel trucks).*  
[Effective and nonretroactive as of January 1, 1991.]

(Amended 1989 and 1997)

##### S.1.6.4.2. Product Identity.

- (a) A device shall be able to conspicuously display on each side the identity of the product being dispensed.

- (b) A device designed to dispense more than one grade, brand, blend, or mixture of product also shall be able to display on each side the identity of the grade, brand, blend, or mixture being dispensed.

#### S.1.6.5. Money-Value Computations.

- (a) *A computing device shall compute the total sales price at any single-purchase unit price (i.e., excluding fleet sales, other price contract sales, and truck stop dispensers used only to refuel trucks) for which the product being measured is offered for sale at any delivery possible within either the measurement range of the device or the range of the computing elements, whichever is less.*  
[Effective and nonretroactive as of January 1, 1991.]
- (b) The analog sales price indicated for any delivered quantity shall not differ from a mathematically computed price (quantity x unit price = total sales price) by an amount greater than the value in Table 1.

(Amended 1984, 1989, and 1993)

##### S.1.6.5.1. Money-Value Divisions, Analog. -

The values of the graduated intervals representing money values on a computing type device shall be no greater than those in Table 1.  
(Amended 1991)

Table 1. Money-Value Divisions and Maximum Allowable Variations for Money-Value Computations on Mechanical Analog Computers				
Unit Price		Money Value Division	Maximum Allowable Variation	
From	To and Including		Design Test	Field Test
0	0.25/liter or \$1.00/gallon	1¢	± 1¢	± 1¢
0.25/liter or \$1.00/gallon	0.75/liter or \$3.00/gallon	1¢ or 2¢	± 1¢	± 2¢
0.75/liter or \$3.00/gallon	2.50/liter or \$10.00/gallon	1¢ or 2¢	± 1¢	± 2¢
0.75/liter or \$3.00/gallon	2.50/liter or \$10.00/gallon	5¢	± 2 1/2¢	± 5¢

### 3.30. Liquid-Measuring Devices

#### **S.1.6.5.2. Money-Value Divisions, Digital.** -

A computing type device with digital indications shall comply with the requirements of paragraph G.S.5.5. Money Values, Mathematical Agreement, and the total price computation shall be based on quantities not exceeding 0.05 liter for devices indicating in metric units and 0.01-gallon intervals for devices indicating in inch-pound units.

(Added 1980)

**S.1.6.5.3. Auxiliary Elements.** - *If a system is equipped with auxiliary indications, all indicated money value divisions of the auxiliary element shall be identical with those of the primary element.*

[Nonretroactive as of January 1, 1985.]

**S.1.6.5.4. Selection of Unit Price.** - *Except for dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), when a product or grade is offered for sale at more than one unit price through a computing device, the selection of the unit price shall be made prior to delivery using controls on the device or other customer-activated controls. A system shall not permit a change to the unit price during delivery of product.*

[Nonretroactive as of January 1, 1991.]

(Added 1989) (Amended 1991, 1992, 1993, and 1996)

#### **S.1.6.5.5. Display of Quantity and Total Price.**

– *Except for aviation refueling applications, when a delivery is completed, the total price and quantity for that transaction shall be displayed on the face of the dispenser for at least 5 minutes or until the next transaction is initiated by using controls on the device or other customer-activated controls..*

[Nonretroactive as of January 1, 1994.]

(Added 1992) (Amended 1996 and 2007)

#### **S.1.6.5.6. Display of Quantity and Total Price, Aviation Refueling Applications.**

(a) *The quantity shall be displayed throughout the transaction.*

(b) *The total price shall be also displayed under one of the following conditions:*

i. *The total price can appear on the face of the dispenser or through a controller adjacent to the device.*

ii. *If a device is designed to continuously compute and display the total price, then the total price shall be computed and displayed throughout the transaction for the quantity delivered.*

(c) *The total price and quantity shall be displayed for at least 5 minutes or until the next transaction is initiated by using controls on the device or other customer-activated controls.*

(d) *A printed receipt shall be available and shall include, at a minimum, the total price, quantity, and unit price.*

[Nonretroactive as of January 1, 2008]

(Added 2007)

**S.1.6.6. Agreement Between Indications.** - When a quantity value indicated or recorded by an auxiliary element is a derived or computed value based on data received from a retail motor fuel dispenser, the value may differ from the quantity value displayed on the dispenser, provided the following conditions are met:

(a) all total money values for an individual sale that are indicated or recorded by the system agree, and

(b) *within each element, the values indicated or recorded meet the formula (quantity x unit price = total sales price) to the closest cent.*

[Nonretroactive as of January 1, 1988.]

(Added 1985) (Amended 1987 and 1988)

**S.1.6.7. Recorded Representations.** - *Except for fleet sales and other price contract sales, a printed receipt providing the following information shall be available through a built-in or separate recording element for all transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash.*

(a) *the total volume of the delivery,*

(b) *the unit price,*

(c) *the total computed price, and*

(d) *the product identity by name, symbol, abbreviation, or code number.*

[Nonretroactive as of January 1, 1986.]

(Added 1985) (Amended 1997)

#### **S.1.6.8. Lubricant Devices, Travel of Indicator.** –

The indicator shall move at least 2.5 cm (1 in) in relation to the graduations, if provided, for a delivery of 0.5 L (1 pt).

#### S.1.7. Additional Operating Requirements, Wholesale Devices Only.

(Amended 2006)

**S.1.7.1. Travel of Indicator.** - A wholesale device shall be readily operable to deliver accurately any quantity from 200 L (50 gal) to the capacity of the device. If the most sensitive element of the indicating system utilizes an indicator and graduations, the relative movement of these parts corresponding to a delivery of 4 L (1 gal) shall be not less than 5 mm (0.20 in).  
(Amended 1987)

**S.1.7.2. Money Values-Mathematical Agreement.** - Any digital money-value indication and any recorded money value on a computing-type device shall be in mathematical agreement with its associated quantity indication or representation to within one cent of money value.

(a) A liquid-measuring device shall be equipped with a vapor or air eliminator or other automatic means to prevent the passage of vapor and air through the meter.

(b) Vent lines from the air or vapor eliminator shall be made of metal tubing or other rigid material.

(Amended 1975)

#### S.2.1.1. Vapor Elimination on Loading Rack Metering Systems.

(a) A loading rack metering system shall be equipped with a vapor or air eliminator or other automatic means to prevent the passage of vapor and air through the meter unless the system is designed or operationally controlled by a method, approved by the weights and measures jurisdiction having control over the device, such that air and/or vapor cannot enter the system.

(b) Vent lines from the air or vapor eliminator (if present) shall be made of metal tubing or other rigid material.

(Added 1994)

### S.2. Measuring Elements.

#### S.2.1. Vapor Elimination.

<b>Table S.2.2. Categories of Device and Methods of Sealing</b>	
<i>Category of Device</i>	<i>Method of Sealing</i>
<i>Category 1: No remote configuration capability.</i>	<i>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</i>
<i>Category 2: Remote configuration capability, but access is controlled by physical hardware.</i>  <i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</i>	<i>[The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.]*</i> <i>[*Nonretroactive as of January 1, 1996]</i>
<i>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</i> <i>[Nonretroactive as of January 1, 1995.]</i>  <i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</i> <i>[Nonretroactive as of January 1, 2001]</i>	<i>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</i>

*[Nonretroactive as of January 1, 1995.]*

(Table added 1993) (Amended 1995, 1998, 1999, 2005 and 2006)

### 3.30. Liquid-Measuring Devices

**S.2.2. Provision for Sealing.** - Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment can be made of:

- (a) any measuring or indicating element,
- (b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries, and
- (c) any metrological parameter that will affect the metrological integrity of the device or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

*[Audit trails shall use the format set forth in Table S.2.2.]\**  
*[\*Nonretroactive as of January 1, 1995.]*  
(Amended 1991, 1993, 1995, 2003 and 2006)

**S.2.2.1. Multiple Measuring Elements With a Single Provision for Sealing.** - *A change to the adjustment of any measuring element shall be individually identified.*  
*[Nonretroactive as of January 1, 2005]*

**Note 1:** Examples of acceptable identification of a change to the adjustment of a measuring element include, but are not limited to:

- (a) a broken, missing, or replaced physical seal on an individual measuring element;
  - (b) a change in a calibration factor for each measuring element;
  - (c) a display of the date or the number of days since the last calibration event for each measuring element; or
  - (d) a counter indicating the number of calibration events per measuring element.
- (Added 2004) (Amended 2006)

**Note 2:** Paragraph S.2.2.1. Multiple Measuring Elements with a Single Provision for Sealing will be removed in the 2010 edition of Handbook 44 when General Code paragraph G-S.8.1. Multiple Weighing or Measuring Elements with a Single Provision for Sealing becomes effective.  
(Added 2007)

**S.2.3. Directional Flow Valves.** - Valves intended to prevent reversal of flow shall be automatic in operation.

#### S.2.4. Stop Mechanism.

**S.2.4.1. Indication.** - The delivery for which the

device is set shall be conspicuously indicated.  
(Amended 1983)

**S.2.4.2. Stroke Limiting Elements.** - Stops or other stroke limiting elements subject to direct pressure or impact shall be:

- (a) made secure by positive, nonfrictional engagement of these elements; and
  - (b) adjustable to provide for deliveries within tolerances.
- (Amended 1983)

**S.2.4.3. Setting.** - If two or more stops or other elements may be selectively brought into operation to permit predetermined quantities of deliveries,

- (a) the position for the proper setting of each such element shall be accurately defined; and
  - (b) any inadvertent displacement from the proper setting shall be obstructed.
- (Amended 1983)

**S.2.5. Zero-Set-Back Interlock, Retail Motor-Fuel Devices.** - A device shall be constructed so that:

- (a) after a delivery cycle has been completed by moving the starting lever to any position that shuts off the device, an automatic interlock prevents a subsequent delivery until the indicating elements, and recording elements if the device is equipped and activated to record, have been returned to their zero positions;
  - (b) the discharge nozzle cannot be returned to its designed hanging position (that is, any position where the tip of the nozzle is placed in its designed receptacle and the lock can be inserted) until the starting lever is in its designed shut-off position and the zero-set-back interlock has been engaged; and
  - (c) in a system with more than one dispenser supplied by a single pump, an effective automatic control valve in each dispenser prevents product from being delivered until the indicating elements on that dispenser are in a correct zero position.
- (Amended 1981 and 1985)

**S.2.6. Temperature Determination - Wholesale Devices.** - *For test purposes, means shall be provided (e.g., thermometer well) to determine the temperature of the liquid either:*

- (a) *in the liquid chamber of the meter, or*
  - (b) *immediately adjacent to the meter in the meter inlet or discharge line.*
- [Nonretroactive as of January 1, 1985.]*  
(Added 1984) (Amended 1986)

#### S.2.7. Wholesale Devices Equipped with Automatic Temperature Compensators.

##### S.2.7.1. Automatic Temperature Compensation.

A device may be equipped with an automatic means for adjusting the indication and registration of the measured volume of product to the volume at 15°C (60°F).

**S.2.7.2. Provision for Deactivating.** - On a device equipped with an automatic temperature-compensating mechanism that will indicate or record only in terms of gallons compensated to 15°C (60°F), provision shall be made for deactivating the automatic temperature-compensating mechanism so that the meter can indicate, and record if it is equipped to record, in terms of the uncompensated volume.  
(Amended 1972)

**S.2.7.3. Provision for Sealing Automatic Temperature Compensating Systems.** - Provision shall be made for applying security seals in such a manner that an automatic temperature-compensating system cannot be disconnected and that no adjustment may be made to the system without breaking the seal.

**S.2.7.4. Temperature Determination with Automatic Temperature Compensation.** - For test purposes, means shall be provided (e.g., thermometer well) to determine the temperature of the liquid either:

- (a) in the liquid chamber of the meter, or
- (b) immediately adjacent to the meter in the meter inlet or discharge line.  
(Amended 1987)

**S.2.8. Exhaustion of Supply, Lubricant Devices Other Than Meter Types.** - When the level of the supply of lubricant becomes so low as to compromise the accuracy of measurement, the device shall:

- (a) become inoperable automatically, or
- (b) give a conspicuous and distinct warning.

#### S.3. Discharge Lines and Valves.

**S.3.1. Diversion of Measured Liquid.** - No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the meter or its discharge line. Two or more delivery outlets may be installed only if automatic means are provided to ensure that:

- (a) liquid can flow from only one outlet at a time, and

- (b) the direction of flow for which the mechanism may be set at any time is clearly and conspicuously indicated.

An outlet that may be opened for purging or draining the measuring system or for recirculating, if recirculation is required in order to maintain the product in a deliverable state, shall be permitted only when the system is measuring food products, agri-chemicals, biodiesel, or biodiesel blends. Effective automatic means shall be provided to prevent passage of liquid through any such outlet during normal operation of the measuring system and to inhibit meter indications (or advancement of indications) and recorded representations while the outlet is in operation.

(Amended 1991, 1995, 1996, and 2007)

**S.3.2. Exceptions.** - The provisions of S.3.1. Diversion Prohibited shall not apply to truck refueling devices when diversion of flow to other than the receiving vehicle cannot readily be accomplished and is readily apparent. Allowable deterrents include, but are not limited to, physical barriers to adjacent driveways, visible valves, or lighting systems that indicate which outlets are in operation, and explanatory signs.  
(Amended 1982, 1990, 1991 and 2002)

**S.3.3. Pump-Discharge Unit.** - A pump-discharge unit equipped with a flexible discharge hose shall be of the wet-hose type.

**S.3.4. Gravity-Discharge Unit.** - On a gravity-discharge unit:

- (a) the discharge hose or equivalent pipe shall be of the dry-hose type with no shutoff valve at its outlet end unless the hose or pipe drains to the same level under all conditions of use;
- (b) the dry hose shall be sufficiently stiff and only as long as necessary to facilitate drainage;
- (c) an automatic vacuum breaker, or equivalent mechanism, shall be incorporated to prevent siphoning and to ensure rapid and complete drainage; and
- (d) the inlet end of the hose or outlet pipe shall be high enough to ensure complete drainage.

**S.3.5. Discharge Hose, Reinforcement.** - A discharge hose shall be reinforced so that the performance of the device is not affected by the expansion or contraction of the hose.

**S.3.6. Discharge Valve.** - A discharge valve may be installed in the discharge line only if the device is of the wet-hose type. Any other shutoff valve on the discharge side of the meter shall be of the automatic or semi-automatic predetermined-stop type or shall be operable only:

### 3.30. Liquid-Measuring Devices

- (a) by means of a tool (but not a pin) entirely separate from the device, or
- (b) by mutilation of a security seal with which the valve is sealed open.

**S.3.7. Antidrain Means.** - In a wet-hose pressure-type device, means shall be incorporated to prevent the drainage of the discharge hose.  
(Amended 1990)

#### S.4. Marking Requirements.

**S.4.1. Limitation on Use.** - The limitations on its use shall be clearly and permanently marked on any device intended to measure accurately only:

- (a) products having particular properties; or
- (b) under specific installation or operating conditions; or
- (c) when used in conjunction with specific accessory equipment.

**S.4.2. Air Pressure.** - If a device is operated by air pressure, the air pressure gauge shall show by special graduations or other means the maximum and minimum working pressures recommended by the manufacturer.

#### S.4.3. Wholesale Devices.

**S.4.3.1. Discharge Rates.** - A wholesale device shall be marked to show its designed maximum and minimum discharge rates. However, the minimum discharge rate shall not exceed 20 percent of the maximum discharge rate.

**S.4.3.2. Temperature Compensation.** - If a device is equipped with an automatic temperature compensator, the primary indicating elements, recording elements, and recorded representation shall be clearly and conspicuously marked to show that the volume delivered has been adjusted to the volume at 15 °C (60 °F).

#### S.4.4. Retail Devices.

**S.4.4.1. Discharge Rates.** - *On a retail device with a designed maximum discharge rate of 115 L (30 gal) per minute or greater, the maximum and minimum discharge rates shall be marked in accordance with S.4.4.2. The marked minimum discharge rate shall not exceed 20% of the marked maximum discharge rate.*

*[Nonretroactive as of January 1, 1985.]*  
(Added 1984) (Amended 2002 and 2003)

Example: With a marked maximum discharge rate of 230 L/min (60 gpm), the marked minimum

discharge rate shall be 45 L/min (12 gpm) or less (e.g., 40 L/min (10 gpm) is acceptable). A marked minimum discharge rate greater than 45 L/min (12 gpm) (e.g., 60 L/min [15 gpm]) is not acceptable.  
(Added 2003)

**S.4.4.2. Location of Marking Information; Retail Motor-Fuel Dispensers.** - *The marking information required in the General Code, Paragraph G-S.1. Identification shall appear as follows:*

- (a) *within 60 cm (24 in) to 150 cm (60 in) from the base of the dispenser;*
- (b) *either internally and/or externally provided the information is permanent and easily read; and*
- (c) *on a portion of the device that cannot be readily removed or interchanged (i.e., not on a service access panel).*

**Note:** *The use of a dispenser key or tool to access internal marking information is permitted for Retail Liquid Measuring Devices.*

*[Nonretroactive as of January 1, 2003]*

(Added 2002) (Amended 2004 and 2006)

**S.5. Totalizers for Retail Motor-Fuel Dispensers.** - *Retail motor-fuel dispensers shall be equipped with a nonresettable totalizer for the quantity delivered through the metering device.*

*[Nonretroactive as of January 1, 1995.]*

(Added 1993) (Amended 1994 and 1997)

## N. Notes

### N.1. Test Liquid.

**N.1.1. Type of Liquid.** - The liquid used for testing a liquid-measuring device shall be the type the device is used to measure, or another liquid with the same general physical characteristics.

**N.1.2. Labeling.** - Following the completion of a successful examination of a wholesale device, the weights and measures official should attach a label or tag indicating the type of liquid used during the test.

**N.2. Volume Change.** - Care shall be taken to minimize changes in volume of the test liquid due to temperature changes and evaporation losses.

**N.3. Test Drafts.**

**N.3.1. Retail Piston-Type and Visible-Type Devices.** – Test drafts shall include the full capacity delivery and each intermediate delivery for which the device is designed.

**N.3.2. Slow Flow Meters.** - Test drafts shall be equal to at least four times the minimum volume that can be measured and indicated through either a visible indication or an audible signal.

**N.3.3. Lubricant Devices.** - Test drafts shall be 1 L (1 qt). Additional test drafts may include 0.5 L (1 pt), 4 L (4 qt), and 6 L (6 qt).

**N.3.4. Other Retail Devices.** - On devices with a designed maximum discharge rate of:

- (a) less than 80 L (20 gal) per minute, tests shall include drafts of one or more amounts, including a draft of at least 19 liters (5 gal).
- (b) 80 L (20 gal) per minute or greater, tests shall include drafts of one or more amounts, including a draft of at least the amount delivered by the device in one minute at the maximum flow rate of the installation.  
(Amended 1984)

**N.3.5. Wholesale Devices.** - The delivered quantity should be equal to at least the amount delivered by the device in one minute at its maximum discharge rate, and shall in no case be less than 200 L (50 gal).  
(Amended 1987 and 1996)

**N.4. Testing Procedures.**

**N.4.1. Normal Tests.** - The “normal” test of a device shall be made at the maximum discharge flow rate developed under the conditions of installation. Any additional tests conducted at flow rates down to and including one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests.  
(Amended 1991)

**N.4.1.1. Wholesale Devices Equipped with Automatic Temperature-Compensating Systems.**

[NOT ADOPTED]

**N.4.1.2. Repeatability Tests.** - Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors, such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained.  
(Added 2001)

**4002.8. Liquid-Measuring Devices. (3.30.)**

**(a) Wholesale Devices Equipped With Automatic Temperature Compensating Systems.** On wholesale devices equipped with automatic temperature compensating systems, normal tests:

- (1) shall be conducted with the temperature compensating system connected and operating by comparing the compensated volume indicated or recorded to the actual delivered volume corrected to 60°F, and
- (2) may be conducted with the temperature compensating system deactivated by comparing the uncompensated volume indicated or recorded to the actual delivered volume.

The first test shall be performed with the automatic temperature compensating system operating in the “as found” condition.

On devices that indicate or record both the compensated and uncompensated volume for each delivery, the tests in (1) and (2) may be performed as a single test.

**N.4.2. Special Tests.** - “Special” tests shall be made to develop the operating characteristics of a device and any special elements and accessories attached to or associated with the device. Any test except as set forth in N.4.1. shall be considered a special test.  
(Amended 2005)

**N.4.2.1. Slow-Flow Meters.** - A “special” test shall be made at a flow rate:

- (a) not larger than twice the actual minimum flow rate, and
- (b) not smaller than the actual minimum flow rate of the installation.

**N.4.2.2. Retail Motor-Fuel Devices.**

- (a) Devices without a marked minimum flow-rate shall have a “special” test performed at the slower of the following rates:



### 3.30. Liquid-Measuring Devices

- (1) 19 L (5 gal) per minute, or
- (2) the minimum discharge rate at which the device will deliver when equipped with an automatic discharge nozzle set at its slowest setting.

- (b) Devices with a marked minimum flow-rate shall have a “special” test performed at or near the marked minimum flow rate.

(Added 1984) (Amended 2005)

**N.4.2.3. Other Retail Devices.** - “Special” tests of other retail devices shall be made at the slower of the following rates:

- (a) 50 percent of the maximum discharge rate developed under the conditions of installation, or
- (b) the minimum discharge rate marked on the device.

**N.4.2.4. Wholesale Devices.** - “Special” tests shall be made to develop the operating characteristics of a measuring system and any special associated or attached elements and accessories. “Special” tests shall include a test at the slower of the following rates:

- (a) 20 percent of the marked maximum discharge rate; or
- (b) the minimum discharge rate marked on the device.

#### N.4.3. Money-Value Computation Tests.

**N.4.3.1. Laboratory Tests.** - When testing the device in the laboratory:

- (a) compliance with paragraph S.1.6.5., Money Value Computations, shall be determined by using the cone gear as a reference for the total quantity delivered;
- (b) the indicated quantity shall agree with the cone gear representation with the index of the indicator within the width of the graduation; and
- (c) the maximum allowable variation of the indicated sales price shall be as shown in Table 1.  
(Amended 1984)

**N.4.3.2. Field Tests.** - In the conduct of field tests to determine compliance with paragraph S.1.6.5., the maximum allowable variation in the indicated sales price shall be as shown in Table 1.  
(Added 1982; Amended 1984)

**N.5. Temperature Correction on Wholesale Devices.** - Corrections shall be made for any changes in volume resulting from the differences in liquid temperatures between time of passage through the meter and time of volumetric determination in the prover. When adjustments are necessary, appropriate petroleum measurement tables should be used.  
(Amended 1974)

### T. Tolerances

**T.1. Application to Underregistration and to Over-registration.** The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of over-registration, whether or not a device is equipped with an automatic temperature compensator.

**T.2. Tolerance Values.** - Maintenance, Acceptance, and Special Test Tolerances shall be as shown in Table T.2.  
(Amended 2002)

**T.3. Repeatability.** - When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 percent of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. This tolerance does not apply to the test of the automatic temperature compensating system. See also N.4.1.2.  
(Added 1992) (Amended 2001 and 2002)

**T.4. Automatic Temperature Compensating Systems.** - *The difference between the meter error (expressed as a percentage) for results determined with and without the automatic temperature compensating system activated shall not exceed:*

- (a) *0.2 percent for mechanical automatic temperature compensating systems; and*
- (b) *0.1 percent for electronic automatic temperature compensating systems.*

*The delivered quantities for each test shall be approximately the same size. The results of each test shall be within the applicable acceptance or maintenance tolerance.  
[Nonretroactive as of January 1, 1988.]*

**Table T.2. Accuracy Classes for Liquid Measuring Devices Covered in  
NIST Handbook 44 Section 3.30**

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance <sup>1</sup>
0.3	-Petroleum products delivered from large capacity (flow rates greater than 115 L/min or 30 gpm)** devices including motor fuel devices -Heated products (other than asphalt) at or greater than 50 °C -Asphalt at or below temperatures 50 °C -All other liquids not shown in the table where the typical delivery is over 200 L (50 gal).	0.2 %	0.3 %	0.5 %
0.3A	-Asphalt at temperatures greater than 50 °C.	0.3 %	0.3 %	0.5 %
0.5*	-Petroleum products delivered from small capacity (at 4 L/min (1 gpm) through 115 L/min or 30 gpm)** motor fuel devices -Agri-chemical liquids -And all other applications not shown in the table where the typical delivery is $\leq$ 200 L (50 gal).	0.3 %	0.5 %	0.5 %
1.1	-Petroleum products and other normal liquids from devices with flow rates** less than 1 gpm -Devices designed to deliver less than one gallon.	0.75 %	1.0 %	1.25 %
<p>*For test drafts <math>\leq</math>40 L or 10 gal, the tolerances specified for Accuracy Class 0.5 in the table above do not apply. For these test drafts, the following applies:</p> <p>(a) Maintenance tolerances on normal and special tests shall be 20 ml plus 4 ml per indicated liter or 1 in<sup>3</sup> plus 1 in<sup>3</sup> per indicated gallon.</p> <p>(b) Acceptance tolerances on normal and special tests shall be one-half the maintenance tolerance values.</p> <p><sup>1</sup> Special test tolerances are not applicable to retail motor fuel dispensers.</p> <p>** Flow rate refers to designed or marked maximum flow rate.</p>				

(Added 2002) (Amended 2006)

### 3.30. Liquid-Measuring Devices

## UR. User Requirements

### UR.1. Selection Requirements.

#### UR.1.1. Discharge Hose.

**UR.1.1.1. Length.** - The length of the discharge hose on a retail motor-fuel device:

- (a) shall be measured from its housing or outlet of the discharge line to the inlet of the discharge nozzle;
- (b) shall be measured with the hose fully extended if it is coiled or otherwise retained or connected inside a housing; and
- (c) shall not exceed 5.5 m (18 ft) unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels.

An unnecessarily remote location of a device shall not be accepted as justification for an abnormally long hose.

(Amended 1972 and 1987)

#### UR.1.1.2. Marinas and Airports.

**UR.1.1.2.1. Length.** - The length of the discharge hose shall be as short as practicable, and shall not exceed 15 m (50 ft) unless it can be demonstrated that a longer hose is essential.

**UR.1.1.2.2. Protection.** - Discharge hoses exceeding 8 m (26 ft) in length shall be adequately protected from weather and other environmental factors when not in use.

(Made retroactive 1974 and amended 1984)

### UR.2. Installation Requirements.

**UR.2.1. Manufacturer's Instructions.** - A device shall be installed in accordance with the manufacturer's instructions, and the installation shall be sufficiently secure and rigid to maintain this condition.

(Added 1987)

**UR.2.2. Discharge Rate.** - A device shall be installed so that the actual maximum discharge rate will not exceed the rated maximum discharge rate. Automatic means for flow regulation shall be incorporated in the installation if necessary.

**UR.2.3. Suction Head.** - A piston-type device shall be installed so that the total effective suction head will not be great enough to cause vaporization of the liquid being dispensed under the highest temperature and lowest barometric pressure likely to occur.

**UR.2.4. Diversion of Liquid Flow.** - A motor-fuel device equipped with two delivery outlets used exclusively in the fueling of trucks shall be so installed that any diversion of flow to other than the receiving vehicle cannot be readily accomplished and is readily apparent. Allowable deterrents include, but are not limited to, physical barriers to adjacent driveways, visible valves, or lighting systems that indicate which outlets are in operation, and explanatory signs.

(Amended 1991)

### UR.2.5. Product Storage Identification.

(a) The fill connection for any petroleum product storage tank or vessel supplying motor-fuel devices shall be permanently, plainly, and visibly marked as to product contained.

(b) When the fill connection device is marked by means of a color code, the color code key shall be conspicuously displayed at the place of business.

(Added 1975 and amended 1976)

### UR.3. Use of Device.

**UR.3.1. Return of Indicating and Recording Elements to Zero.** - On any dispenser used in making retail deliveries, the primary indicating element, and recording element if so equipped, shall be returned to zero before each delivery.

Exceptions to this requirement are totalizers on key-lock-operated or other self-operated dispensers and the primary recording element if the device is equipped to record.

### UR.3.2. Unit Price and Product Identity.

(a) The following information shall be conspicuously displayed or posted on the face of a retail dispenser used in direct sale:

(1) except for dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), all of the unit prices at which the product is offered for sale; and

(2) in the case of a computing type or money-operated type, the unit price at which the dispenser is set to compute.

Provided that the dispenser complies with S.1.6.4.1., it is not necessary that all the unit prices for all grades, brands, blends, or mixtures be simultaneously displayed or posted.

- (c) any metrological parameter that will affect the metrological integrity of the device or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

*[Audit trails shall use the format set forth in Table S.2.2.]\**

*[\*Nonretroactive as of January 1, 1995]*

(Amended 2006)

**S.2.2.1. Milk-Metering Systems.** - Adequate provision shall be made for applying security seals to the adjustment mechanism and the register. The adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

**S.2.3. Directional Flow Valves.** - Valves intended to prevent reversal of flow shall be automatic in operation. However, on equipment used exclusively for fueling aircraft, such valves may be manual in operation.

**S.2.4. Zero-Set-Back Interlock, Vehicle-Tank Meters, Electronic.** - Except for vehicle-mounted metering systems used solely for the delivery of aviation fuel, a device shall be so constructed that after an individual or multiple deliveries at one location have been completed, an automatic interlock system shall engage to prevent a subsequent delivery until the indicating and, if equipped, recording elements have been returned to their zero position. For individual deliveries, if there is no product flow for 3 minutes the transaction must be completed before additional product flow is allowed. The 3-minute timeout shall be a sealable feature on an indicator.

*[Nonretroactive as of January 1, 2006]*

(Added 2005)

<b>Table S.2.2. Categories of Device and Methods of Sealing</b>	
<b>Category of Device</b>	<b>Method of Sealing</b>
<i>Category 1: No remote configuration capability.</i>	<i>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</i>
<i>Category 2: Remote configuration capability, but access is controlled by physical hardware.</i>  <i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</i>	<i>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.</i>
<i>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</i>  <i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</i>	<i>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</i>

*[Nonretroactive as of January 1, 1995]*

(Table Added 2006)

### 3.31. Vehicle-Tank Meters

#### S.2.5. Automatic Temperature Compensation for Refined Petroleum Products.

**S2.5.1. Automatic Temperature Compensation for Refined Petroleum Products.** - A device may be equipped with an automatic means for adjusting the indication and registration of the measured volume of product to the volume at 15 °C for liters or the volume at 60 °F for gallons and decimal subdivisions or fractional equivalents thereof where not prohibited by state law.

**S2.5.2. Provision for Deactivating.** - On a device equipped with an automatic temperature-compensating mechanism that will indicate or record only in terms of liters compensated to 15 °C or gallons compensated to 60 °F, provision shall be made for deactivating the automatic temperature-compensating mechanism so the meter can indicate and record, if it is equipped to record, in terms of the uncompensated volume.

**S.2.5.3. Gross and Net Indications.** - A device equipped with automatic temperature compensation shall indicate or record, if equipped to record, both the gross (uncompensated) and net (compensated) volume for testing purposes. It is not necessary that both net and gross volume be displayed simultaneously.

**S.2.5.4 Provision for Sealing Automatic Temperature-Compensating Systems.** - Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that an automatic temperature-compensating system cannot be disconnected and no adjustment may be made to the system.

**S.2.5.5. Temperature Determination with Automatic Temperature Compensation.** - For test purposes, means shall be provided (e.g., thermometer well) to determine the temperature of the liquid either:

- (a) in the liquid chamber of the meter, or
- (b) immediately adjacent to the meter inlet or discharge line  
(Added 2007)

#### S.3. Design of Discharge Lines and Discharge Line Valves. (Not applicable to milk-metering systems.)

**S.3.1. Diversion of Measured Liquid.** - Except on equipment used exclusively for fueling aircraft, no means shall be provided by which any measured liquid can be diverted from the measuring chamber of the meter or the discharge line therefrom. However, two or more delivery

outlets may be installed if means is provided to insure that:

- (a) liquid can flow from only one such outlet at one time, and
- (b) the direction of flow for which the mechanism may be set at any time is definitely and conspicuously indicated.

**S.3.2. Pump-Discharge Unit.** - On a pump-discharge unit, the discharge hose shall be of the wet-hose type with a shutoff valve at its outlet end. However, a pump-discharge unit may be equipped also with a dry hose without a shutoff valve at its outlet end, but only if:

- (a) the dry hose is as short as practicable, and
- (b) there is incorporated in the discharge piping, immediately adjacent to the meter, effective means to insure that liquid can flow through only one of the discharge hoses at any one time and that the meter and the wet hose remain full of liquid at all times.

**S.3.3. Gravity-Discharge Unit.** - On a gravity-discharge unit, the discharge hose or equivalent pipe shall be of the dry-hose type with no shutoff valve at its outlet end. The dry hose shall be of such stiffness and only of such length as to facilitate its drainage. The inlet end of the hose or of an equivalent outlet pipe shall be of such height as to provide for proper drainage of the hose or pipe. There shall be incorporated an automatic vacuum breaker or equivalent means to prevent siphoning and to insure the rapid and complete drainage.

**S.3.4. Discharge Hose.** - A discharge hose shall be adequately reinforced.

**S.3.5. Discharge Valve.** - A discharge valve may be installed in the discharge line only if the device is of the wet-hose type, in which case such valve shall be at the discharge end of the line. Any other shutoff valve on the discharge side of the meter shall be of the automatic or semiautomatic predetermined-stop type or shall be operable only:

- (a) by means of a tool (but not a pin) entirely separate from the device, or
- (b) by mutilation of a security seal with which the valve is sealed open.

**S.3.6. Antidrain Valve.** - In a wet-hose, pressure-type device, an effective antidrain valve shall be incorporated in the discharge valve or immediately adjacent thereto. The antidrain valve shall function so as to prevent the drainage of the discharge hose. However, a device used exclusively for fueling and defueling aircraft may be of the pressure type without an antidrain valve.

**S.4. Design of Intake Lines (for Milk-Metering Systems).**

**S.4.1. Diversion of Liquid to be Measured.** - No means shall be provided by which any liquid can be diverted from the supply tank to the receiving tank without being measured by the device.

**S.4.2. Intake Hose.** - The intake hose shall be:

- (a) of the dry-hose type;
- (b) adequately reinforced;
- (c) not more than 6 m (20 ft) in length, unless it can be demonstrated that a longer hose is essential to permit pickups from a supply tank; and
- (d) connected to the pump at horizontal or above, to permit complete drainage of the hose.

**S.5. Marking Requirements**

**S.5.1. Limitation of Use.** - If a meter is intended to measure accurately only liquids having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently stated on the meter.

**S.5.2. Discharge Rates.** - A meter shall be marked to show its designed maximum and minimum discharge rates. However, the minimum discharge rate shall not exceed 20% of the maximum discharge rate.

**Note:** See example in Section 3.30. Liquid-Measuring Devices Code, paragraph S.4.4.1.  
(Added 2003)

**S.5.3. Measuring Components Milk-Metering System.** All components that affect the measurement of milk that are disassembled for cleaning purposes shall be clearly and permanently identified with a common serial number.

**S.5.4. Flood Volume, Milk-Metering System.** - When applicable, the volume of product necessary to flood the system when dry shall be clearly, conspicuously, and permanently marked on the air eliminator.

**S.5.5. Conversion Factor.** - When the conversion factor of 1.03 kg/L (8.6 lb/gal) is used to convert the volume of milk to weight, the conversion factor shall be clearly marked on the primary indicating element and recorded on the delivery ticket.  
(Added 1989)

**S.5.6. Temperature Compensation for Refined Petroleum Products.** - If a device is equipped with an automatic temperature compensator, the primary indicating elements, recording elements, and recorded representations shall be clearly and conspicuously marked to show the volume delivered has been adjusted to the volume at 15 °C for liters or the volume at 60 °F for

gallons and decimal subdivisions or fractional equivalents thereof.  
(Added 2007)

**N. Notes****N.1. Test Liquid.**

- (a) A measuring system shall be tested with the liquid to be commercially measured or with a liquid of the same general physical characteristics. Following a satisfactory examination, the weights and measures official should attach a seal or tag indicating the product used during the test.  
(Amended 1975)
- (b) A milk measuring system shall be tested with the type of milk to be measured when the accuracy of the system is affected by the characteristics of milk (e.g., positive displacement meters).  
(Amended 1989)

**N.2. Evaporation and Volume Change.** - Care shall be exercised to reduce to a minimum, evaporation losses and volume changes resulting from changes in temperature of the test liquid.

**N.3. Test Drafts.** - Test drafts should be equal to at least the amount delivered by the device in 1 minute at its maximum discharge rate, and shall in no case be less than 180 L (50 gal) or 225 kg (500 lb).  
(Amended 1989)

**N.4. Testing Procedures**

**N.4.1. Normal Tests.** - The “normal” test of a measuring system shall be made at the maximum discharge rate that may be anticipated under the conditions of the installation. Any additional tests conducted at flow rates down to and including one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests.  
(Amended 1992)

**N.4.1.1. Milk Measuring System.** - The “normal” test shall include a determination of the effectiveness of the air elimination system.

**N.4.1.2. Repeatability Tests.** - Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as, temperature pressure and flow rate are reduced to the extent that they will not affect the results obtained.  
(Added 2001)

### 3.31. Vehicle-Tank Meters

**N.4.1.3. Automatic Temperature-Compensating Systems for Refined Petroleum Products.** - On devices equipped with automatic temperature-compensating systems, normal tests shall be conducted:

(a) by comparing the compensated volume indicated or recorded to the actual delivered volume corrected to 15 °C for liters or 60 °F for gallons and decimal subdivisions or fractional equivalents thereof; and

(b) with the temperature-compensating system deactivated, comparing the uncompensated volume indicated or recorded to the actual delivered volume.

The first test shall be performed with the automatic temperature-compensating system operating in the “as-found” condition. On devices that indicate or record both the compensated and uncompensated volume for each delivery, the tests in (a) and (b) may be performed as a single test.

(Added 2007)

**N.4.2. Special Tests (Except Milk-Measuring Systems).** “Special” tests shall be made to develop the operating characteristics of a measuring system and any special elements and accessories attached to or associated with the device. Any test except as set forth in N.4.1. and N.4.5. shall be considered a special test. Special test of a measuring system shall be made at a minimum discharge rate of 20% of the marked maximum discharge rate or at the minimum discharge rate marked on the device whichever is less.

(Amended 1978 and 2005)

**N.4.3. Antidrain Valve Test.** - The effectiveness of the antidrain valve shall be tested after the pump pressure in the measuring system has been released and a valve between the supply tank and the discharge valve is closed.

**N.4.4. System Capacity.** - The test of a milk-measuring system shall include the verification of the volume of product necessary to flood the system as marked on the air eliminator.

**N.4.5. Product Depletion Test.** - Except for vehicle-mounted metering systems used solely for the delivery of aviation fuel, the effectiveness of the vapor eliminator or vapor elimination means shall be tested by dispensing product at the normal flow rate until the product supply is depleted and continuing until the lack of fluid causes the meter indication to stop completely for at least 10 seconds. If the meter indication fails to stop completely for at least 10 seconds, continue to operate the system for 3 minutes. Finish the test by switching to another compartment with sufficient product to complete the test on a multi-compartment vehicle or by adding sufficient product to complete the test to a single compartment vehicle. When adding product to a single compartment vehicle, allow appropriate time for any entrapped vapor to disperse before continuing the test. Test drafts shall be of the same size and run at approximately the same flow rate.

(Added 2005)

**N.5. Temperature Correction for Refined Petroleum Products.** - Corrections shall be made for any changes in volume resulting from the differences in liquid temperatures between the time of passage through the meter and the time of volumetric determination in the prover. When adjustments are necessary, appropriate petroleum measurement tables should be used.

(Added 2007)

## T. Tolerances

### T.1. Application.

#### T.1.1. To Underregistration and to Overregistration.

The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

**T.2. Tolerance Values.** - Tolerances shall be as shown in Tables 1 and 2.

(Amended 1995, 2002 and 2006)

#### T.2.1. Automatic Temperature-Compensating Systems. -

The difference between the meter error (expressed as a percentage) for results determined with and without the automatic temperature-compensating system activated shall not exceed:

- (a) 0.4% for mechanical automatic temperature-compensating systems; and
- (b) 0.2% for electronic automatic temperature compensating systems.

The delivered quantities for each test shall be approximately the same size. The results of each test shall be within the applicable acceptance or maintenance tolerance.

(Added 2007)

**T.3. Repeatability.** - When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 percent absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. See also N.4.1.2.

(Added 1992) (Amended 2001 and 2002)

**Table 1. Tolerances for Vehicle-Tank Meter Accuracy Classes Covered in NIST Handbook 44, Section 3.31**

Accuracy Class	Application		Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance
0.3	-Petroleum products including large capacity motor fuel devices (flow rates over 115 L/min (30 gpm))**, -Heated products at or greater than 50 °C -Asphalt at or below temperatures 50 °C -All other liquids not shown in the table where the typical delivery is greater than 200 L (50 gal).		0.15 %	0.3 %	0.45 %
0.3A	-Asphalt at temperatures greater than 50 °C.		0.3 %	0.3 %	0.5 %
0.5*	-Petroleum products delivered from small capacity (at 4 L/min (1 gpm) through 115 L/min or 30 gpm)** motor-fuel devices -Agri-chemical liquids -All other applications not shown in the table where typical delivery is ≤200L (50 gal).		0.3 %	0.5 %	0.5 %
1.1	-Petroleum products and other normal liquids from devices with flow rates** less than 4 L/min (1 gpm) and -Devices designed to deliver less than 4 L (1 gal).		0.75 %	1.0 %	1.25 %
1.5	-Water	Overregistration	1.5 %	1.5 %	1.5 %
		Underregistration	1.5 %	1.5 %	5.0 %
* For 5-gal and 10-gal test drafts, the tolerances specified for Accuracy Class 0.5 in the table above do not apply. For these test drafts, the maintenance tolerances on normal and special tests for 5-gal and 10-gal test drafts are 6 in³ and 11 in³, respectively. Acceptance tolerances on normal and special tests are 3 in³ and 5.5 in³.					
** Flow rate refers to designed or marked maximum flow rate.					

(Added 2002)

**Table 2. Tolerances for Vehicle-Mounted Milk Meters**

Indication	Maintenance	Acceptance
gallons	gallons	gallons
100	0.5	0.3
200	0.7	0.4
300	0.9	0.5
400	1.1	0.6
500	1.3	0.7
Over 500	Add 0.002 gallon per indicated gallon over 500	Add 0.001 gallon per Indicated gallon over 500

(Added 1989)



### 3.31. Vehicle-Tank Meters

**T.4. Product Depletion Test.** - The difference between the test result for any normal test and the product depletion test shall not exceed the tolerance shown in Table T.4. Test drafts shall be of the same size and run at approximately the same flow rate.  
(Amended 2006)

[**Note:** The result of the product depletion test may fall outside of the applicable test tolerance as specified in Table T.2.]  
(Added 2005)

Table T.4. Tolerances for Vehicle-Tank Meters on Product Depletion Tests, Except Milk Meters	
Meter Size	Maintenance and Acceptance Tolerances
Up to but not including 50 mm (2 in)	1.70 L (104 in <sup>3</sup> ) <sup>1</sup>
From 50 mm (2 in) up to but not including 75 mm (3 in)	2.25 L (137 in <sup>3</sup> ) <sup>1</sup>
75 mm (3 in) or larger	3.75 L (229 in <sup>3</sup> ) <sup>1</sup>
<sup>1</sup> Based on a test volume of at least the amount specified in N.3.	

(Table Added 2005)

## UR. User Requirements

### UR.1. Installation Requirements.

**UR.1.1. Discharge Rate.** - A meter shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation, in which case this shall be fully effective and automatic in operation.

**UR.1.2. Unit Price.** - There shall be displayed on the face of a device of the computing type the unit price at which the device is set to compute.

**UR.1.3. Intake Hose.** - The intake hose in a milk-metering system shall be installed to permit complete drainage and ensure that all available product is measured following each pickup.

**UR.1.4. Liquid Measured.** - A vehicle-tank meter shall continue to be used to measure the same liquid or one with the same general physical properties as that used for calibration and weights and measures approval unless the meter is recalibrated with a different product and tested by a registered service agency or a weights and measures official and approved by the weights and measures jurisdiction having statutory authority over the device.  
(Added 2003)

### UR.2. Use Requirements.

**UR.2.1. Return of Indicating and Recording Elements to Zero.** - The primary indicating elements (visual), and the primary recording elements, when these are returnable to zero, shall be returned to zero immediately before each delivery is begun and after the pump has been activated and the product to be measured has been supplied to the measuring system.  
(Amended 1981)

### UR.2.2. Ticket Printer; Customer Ticket. [NOT ADOPTED]

### Section 4002.3. Vehicle-Tank Meters. (3.31.)

**UR.2.2. Ticket Printer; Customer Ticket.** Vehicle-mounted metering systems shall be equipped with a ticket printer which shall be used for all sales where product is delivered through the meter. A copy of the ticket issued by the device shall be left with the customer at the time of delivery or as otherwise specified by the customer.

[Nonretroactive as of January 1, 1995.]

**UR.2.2.1. Exceptions for the Sale of Aviation Fuel.** - The provisions of UR.2.2. Ticket Printer; Customer Ticket shall not apply to vehicle-mounted metering systems used solely for the delivery of aviation fuel into aircraft and for aircraft-related operations.  
(Added 1999) (Amended 2005)

**UR.2.3. Ticket in Printing Device.** - A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

**UR.2.4. Credit for Flood Volume.** - The volume of product necessary to flood the system as marked on the air eliminator shall be individually recorded on the pickup ticket of each seller affected.

**UR.2.5. Automatic Temperature Compensation for Refined Petroleum Products.**

**UR.2.5.1. When to be Used.** - In a state that does not prohibit, by law or regulation, the sale of temperature-compensated product, a device equipped with an operable automatic-temperature compensator shall be connected, operable, and in use at all times. An electronic or mechanical automatic temperature-compensating system may not be removed, nor may a compensated device be replaced with an uncompensated device, without the written approval of the responsible weights and measures jurisdiction.

**Note:** This requirement does not specify the method of sale for products measured through a meter.

**UR.2.5.2. Invoices.** - An invoice based on a reading of a device that is equipped with an automatic temperature compensator shall show that the volume delivered has been adjusted to the volume at 15 °C for liters or the volume at 60 °F for gallons and decimal subdivisions or fractional equivalents thereof.  
(Added 2007)

**N.4.3.1. Laboratory Design Evaluation Tests.** - In the conduct of laboratory design evaluation tests, compliance with paragraph S.1.5.2. shall be determined by using the cone gear as a reference for the total quantity delivered. The indicated delivered quantity shall agree with the cone gear representation with the index of the indicator within the width of the graduation. The maximum allowable variation of the indicated sales price shall be as shown in Table 1.

**N.4.3.2. Field Tests.** - In the conduct of field tests to determine compliance with paragraph S.1.5.2. the maximum allowable variation in the indicated sales price shall be as shown in Table 1.  
(Added 1984)

**N.5. Temperature Correction.** - Adjustments shall be made for any changes in volume resulting from the differences in liquid temperatures between time of passage through the meter and time of volumetric determination in the prover. When adjustments are necessary, appropriate measurement tables should be used.

## T. Tolerances

### T.1. Application.

**T.1.1. To Underregistration and to Overregistration.**  
The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration, whether or not a device is equipped with an automatic temperature compensator.

**T.2. Tolerance Values.** - The maintenance and acceptance tolerances for normal and special tests shall be as shown in Table T.2.  
(Amended 1988, 1992 and 2003)

**T.3. Repeatability.** - When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 percent of the absolute value of the maintenance tolerance and the results of each test shall be within applicable tolerance. This tolerance does not apply to the test of the automatic temperature compensating system. See also N.4.1.2.  
(Added 1992) (Amended 1997 and 2001)

**T.4. Automatic Temperature Compensating Systems.** - The difference between the meter error (expressed as a percentage) for results determined with and without the automatic temperature compensating system activated shall not exceed:

- (a) 1.0 percent for mechanical automatic temperature compensating systems; and
- (b) 0.5 percent for electronic automatic temperature compensating systems.

The delivered quantities for each test shall be approximately the same size. The results of each test shall be within the applicable acceptance or maintenance tolerance.  
(Added 1991) (Amended 1992, 1996, and 1997)

## UR. User Requirements

### UR.1. Installation Requirements.

**UR.1.1. Discharge Rate.** - A device shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation, in which case this shall be fully effective and automatic in operation.

**UR.1.2. Length of Discharge Hose.** - The length of the discharge hose on a stationary motor-fuel device shall not exceed 5.5 m (18 ft), measured from the outside of the housing of the device to the inlet end of the discharge nozzle, unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels. Unnecessarily remote location of a device shall not be accepted as justification for an abnormally long hose.  
(Amended 1991)

### UR.2. Use Requirements.

**UR.2.1. Return of Indication and Recording Elements to Zero.** - The primary indicating elements (visual), and the primary recording elements when these are returnable to zero, shall be returned to zero before each delivery.

**Table T.2. Accuracy Classes and Tolerance for  
LPG and Anhydrous Ammonia Liquid-Measuring Devices**

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance
1.0	Anhydrous ammonia, LPG (including vehicle-mounted meters)	0.6%	1.0%	1.0%

(Added 2003) (Amended 2006)

### 3.32. LPG and Anhydrous Ammonia Liquid-Measuring Devices

**UR.2.2. Condition of Fill of Discharge Hose.** - The discharge hose shall be completely filled with liquid before the “zero” condition is established prior to the start of a commercial delivery, whether this condition is established by resetting the primary indicating elements to zero indication or by recording the indications of the primary indicating elements. (Also see UR.2.1.)

**UR.2.3. Vapor-Return Line.**

[NOT ADOPTED]

#### **4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.)**

**(d) Vapor-Return Line.** During any metered delivery of liquefied petroleum gas from a supplier’s tank to a receiving container, there shall be no vapor-return line from the receiving container to the supplier’s tank.

**UR.2.4. Temperature Compensation.**

**UR.2.4.1. Use of Automatic Temperature Compensators.** - If a device is equipped with an automatic temperature compensator, this shall be connected, operable, and in use at all times. Such automatic temperature compensator may not be removed, nor may a compensated device be replaced with an uncompensated device, without the written approval of the weights and measures authority having jurisdiction over the device.

**UR.2.4.2. Temperature Compensated Sale.** - All sales of liquefied petroleum gas in a liquid state, when the quantity is determined by an approved measuring system equipped with a temperature compensating mechanism, or by weight and converted to liters or gallons, or by a calibrated container, shall be in terms of liters at 15 °C or the United States gallon of 231 in<sup>3</sup> at 60 °F.  
(Added 1984)

**UR.2.4.3. Invoices.** - Any invoice based on a reading of a device that is equipped with an automatic temperature compensator or based on a weight converted to gallons, or based on the volume of a calibrated container, shall have shown thereon that the volume delivered has been adjusted to the volume at 15 °C (60 °F).  
(Amended 1984)

**UR.2.4.4. Automated Temperature-Compensating Systems.** - Means for determining the temperature of measured liquid in an automatic temperature-compensating system shall be so designed and located that, in any “usual and customary” use of the system, the resulting indications and/or recorded representations are within applicable tolerances.  
(Added 1987)

**UR.2.5. Ticket in Printing Device.** - A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

**UR.2.6. Ticket Printer; Customer Ticket.** - Vehicle-mounted metering systems shall be equipped with a ticket printer. The ticket printer shall be used for all sales; a copy of the ticket issued by the device shall be left with the customer at the time of delivery or as otherwise specified by the customer.  
(Added 1992) (Amended 2006)

#### **4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.)**

**(e) Signs.** Any retail liquefied petroleum gas dispenser, with the exception of those mounted on a motor vehicle, shall display a sign showing the price schedule of all transactions. The sign shall be where it is plainly discernable to the customer. All letters, figures or numerals used to express the price schedule shall be at least three-quarters of an inch in height.

**Table T.2. Accuracy Classes for Mass Flow Meter Applications Covered in NIST Handbook 44, Section 3.37**

Accuracy Class	Application or Commodity Being Measured	Acceptance Tolerance	Maintenance Tolerance	Special Tolerance
0.3	-Large capacity motor-fuel dispensers (maximum discharge flow rates greater than 100 L or 25 gallon per minute) -Heated products -Asphalt at or below a temperature of 50 °C -Loading rack meters -Vehicle-tank meters -Home heating oil -Asphalt at or below 50°C -Milk and other food products -All other liquid applications not shown in the table where the minimum delivery is at least 700 kg (1500 lb)	0.2%	0.3%	0.5%
0.3A	-Asphalt at temperatures greater than 50 °C	0.3%	0.3%	0.5%
0.5	-Small capacity (retail) motor-fuel dispensers -Agri-chemical liquids -All other liquid applications not shown in the table	0.3%	0.5%	0.5%
1.0	-Anhydrous ammonia -LP Gas (including vehicle tank meters)	0.6%	1.0%	1.0%
2.0	-Compressed natural gas as a motor fuel	1.5%	2.0%	2.0%
2.5	-Cryogenic liquid meters -Liquefied compressed gases other than LP Gas	1.5%	2.5%	2.5%

(Added 1994) (Amended 1999 and 2001)

**UR. User Requirements**

weights and measures authority; however, the device must perform within the performance requirements for the declared minimum measured quantity.

**UR.1. Selection Requirements.**

**UR.1.1. Discharge Hose-Length.** - The length of the discharge hose on a retail motor-fuel device shall not exceed 4.6 m (15 ft) unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels.

[Nonretroactive as of January 1, 1998]

(Added 1997)

**UR.1.2. Minimum Measured Quantity.**

- The minimum measured quantity shall be specified by the manufacturer.
- The minimum measured quantity appropriate for a transaction may be specified by the weights and measures authority. A device may have a minimum measured quantity smaller than that specified by the

**UR.2. Installation Requirements.**

**UR.2.1. Manufacturer's Instructions.** - A device shall be installed in accordance with the manufacturer's instructions, and the installation shall be sufficiently secure and rigid to maintain this condition.

(Added 1997)

**UR.2.2. Discharge Rate.** - A device shall be installed so that the actual maximum discharge rate will not exceed the rated maximum discharge rate. Automatic means of flow regulation shall be incorporated in the installation if necessary.

(Added 1997)

### 3.37. Mass Flow Meters

**UR.2.3. Low-Flow Cut-Off Valve.** - If a metering system is equipped with a programmable or adjustable "low-flow cut-off" feature:

- (a) the low-flow cut-off value shall not be set at flow rates lower than the minimum operating flow rate specified by the manufacturer on the meter; and
- (b) the system shall be equipped with flow control valves which prevent the flow of product and stop the indicator from registering product flow whenever the product flow rate is less than the low-flow cut-off value.

(Added 1992)

### UR.3. Use of Device.

**UR.3.1. Unit Price and Product Identity for Retail Dispensers.** - The following information shall be conspicuously displayed or posted on the face of a retail dispenser used in direct sale:

- (a) Except for dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), all of the unit prices at which the product is offered for sale; and
- (b) in the case of a computing type or money-operated type, the unit price at which the dispenser is set to compute.

(Added 1993)

**UR.3.2. Vapor-Return Line.** - During any metered delivery of liquefied petroleum gas and other liquids from a supplier's tank to a receiving container, there shall be no vapor-return line from the receiving container to the supplier's tank:

- (a) in the case of any receiving container to which normal deliveries can be made without the use of such vapor-return line, or
- (b) in the case of any new receiving container when the ambient temperature is below 90 °F.

(Added 1993)

**UR.3.3. Ticket Printer; Customer Ticket.** - Vehicle-mounted metering systems shall be equipped with a ticket printer which shall be used for all sales where product is delivered through the meter. A copy of the ticket issued by the device shall be left with the customer at the time of delivery or as otherwise specified by the customer.

(Added 1994) (Amended 2006)

**UR.3.4. Printed Ticket.** - The total price, the total quantity of the delivery, and the price per unit shall be printed on any ticket issued by a device of the computing type and containing any one of these values.

(Added 1993)

**UR.3.5. Ticket in Printing Device.** - A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

(Added 1993)

**UR.3.6. Steps After Dispensing.** - After delivery to a customer from a retail motor-fuel device:

- (a) the starting lever shall be returned to its shutoff position and the zero-set-back interlock engaged; and
- (b) the discharge nozzle shall be returned to its designed hanging position unless the primary indicating elements, and recording elements, if the device is equipped and activated to record, have been returned to a definite zero indication.

(Added 1993)

**UR.3.7. Return of Indicating and Recording Elements to Zero.** - The primary indicating elements (visual), and the primary recording elements when these are returnable to zero, shall be returned to zero immediately before each delivery. Exceptions to this requirement are totalizers on key-lock-operated or other self-operated dispensers and the primary recording element if the device is equipped to record.

(Added 1995) (Amended 1997)

**UR.3.8. Return of Product to Storage, Retail Compressed Natural Gas Dispensers.** - Provisions at the site shall be made for returning product to storage or disposing of the product in a safe and timely manner during or following testing operations. Such provisions may include return lines, or cylinders adequate in size and number to permit this procedure.

(Added 1998)

**S.2.2.2. Power Interruption.** - A power interruption shall not cause an indicating or recording element to display or record any values outside the applicable tolerance limits.  
(Added 1988)

**S.2.3 Level-Indicating Means.** - A meter shall be equipped with a level indicator and leveling adjustments if its performance is changed by an amount greater than the applicable tolerance when the meter is moved from a level position to a position that is out of level in any upright direction by up to 5 percent (approximately 3 degrees).

The level-indicating means shall be readable without removing any meter parts requiring a tool.  
(Added 1988) (Amended 1994)

#### **S.2.4. Calibration Integrity.**

**S.2.4.1. Calibration Version.** - A meter must be capable of displaying either calibration constants, a unique calibration name, or a unique calibration version number for use in verifying that the latest version of the calibration is being used to make moisture content and test weight per bushel determinations.  
(Added 1993) (Amended 1995 and 2003)

**S.2.4.2. Calibration Corruption.** - If calibration constants are digitally stored in an electronically alterable form, the meter shall be designed to make automatic checks to detect corruption of calibration constants. An error message must be displayed if calibration constants have been electronically altered.  
(Added 1993) (Amended 1995)

**S.2.4.3. Calibration Transfer.** - *The instrument hardware/software design and calibration procedures shall permit calibration development and the transfer of calibrations between instruments of like models without requiring user slope or bias adjustments.*

*[Note: Only the manufacturer or the manufacturer's designated service agency may make standardization adjustments on moisture meters. This does not preclude the possibility of the operator installing manufacturer-specified calibration constants under the instructions of the manufacturer or its designated service agency.] Standardization adjustments (not to be confused with grain calibrations) are those physical adjustments or software parameters which make meters of like type respond identically to the grain(s) being measured.*  
*[Nonretroactive as of January 1, 1999.]*  
(Added 1994) (Amended 1998)

**S.2.5. Provision for Sealing.** - Provision shall be made for applying a security seal in a manner that requires the security seal to be broken, or for using other approved means of providing security (e.g., audit trail available at the time of inspection as defined in Table S.2.5.\*) before any change that affects the metrological integrity of the device can be made to any mechanism.

[\*Note: Table S.2.5. is Nonretroactive as of January 1, 1999.]

[Note: Zero-setting and test point adjustments are considered to affect metrological characteristics and must be sealed.]  
(Added 1993) (Amended 1995 and 1997)

#### **S.2.6. Determination of Quantity and Temperature.**

The moisture meter system shall not require the operator to judge the precise volume or weight and temperature needed to make an accurate moisture determination. External grinding, weighing, and temperature measurement operations are not permitted. In addition, if the meter is capable of measuring test weight per bushel, determination of sample volume and weight for this measurement shall be fully automatic *and means shall be provided to ensure that measurements of test weight per volume are not allowed to be displayed or printed when an insufficient sample volume is available to provide an accurate measurement.*

*[Nonretroactive as of January 1, 2004]*

(Added 1994) (Amended 1995 and 2003)

**S.3. Accessory Equipment** - When the operating instructions for a moisture meter require accessory equipment separate from and external to the moisture meter, such equipment shall be appropriate and complete for the measurement.

**S.4. Operating Instructions and Use Limitations.** - The manufacturer shall furnish operating instructions for the device and accessories that include complete information concerning the accuracy, sensitivity, and use of accessory equipment necessary in obtaining a moisture content. Operating instructions shall include the following information:

- (a) name and address or trademark of the manufacturer;
- (b) the type or design of the device with which it is intended to be used;
- (c) date of issue;
- (d) the kinds or classes of grain or seed for which the device is designed to measure moisture content and test weight per bushel;  
(Amended 2003)

## 5.56.(a) Grain Moisture Meters

- (e) the limitations of use, including but not confined to the moisture measurement range, grain or seed temperature, maximum allowable temperature difference between grain sample and meter, kind or class of grain or seed, moisture meter temperature, voltage and frequency ranges, electromagnetic interferences, and necessary accessory equipment.

(Added 1984)

### N. Notes

**N.1. Testing Procedures.** Field evaluation of grain moisture meters shall be performed by one of the following methods:

**N.1.1. Air Oven Reference Method Transfer Standards.**

Official grain samples shall be used as the official transfer standards with moisture content and test weight per bushel values assigned by the reference methods. The reference methods for moisture shall be the oven drying methods as specified by the USDA GIPSA. The test weight per bushel value assigned to a test weight transfer standard shall be the average of 10 test weight per bushel determinations using the quart kettle test weight per bushel apparatus as specified by the USDA GIPSA. Tolerances shall be applied to the average of at least three measurements on each official grain sample. Official grain samples shall be clean and naturally moist, but not tempered (i.e., water not added).

(Amended 1992, 2001 and 2003)

**N.1.2. Minimum Test.** - A minimum test of a grain moisture meter shall consist of tests using samples (need not exceed three) of each grain or seed type for which the device is used, and for each grain or seed type shall include the following:

- (a) tests of moisture indications, using samples having at least two different moisture content values within the operating range of the device; and
- (b) if applicable, tests of test weight per volume indications, with at least the lowest moisture samples used in (a) above.

(Amended 1986, 1989 and 2003)

**N.1.3. Meter to Like-Type Meter Method Transfer Standards.** - Properly standardized reference meters using National Type Evaluation Program approved calibrations shall be used as transfer standards. A reference meter shall be of the same type as the meter under test. Tests shall be conducted side-by-side using, as a comparison medium, grain samples that are clean and naturally moist, but not tempered (i.e., water not added).

(Added 2001)

## T. Tolerances

**T.1. To Underregistration and to Overregistration.** - The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

**T.2. Air Oven Reference Method.** - Maintenance and acceptance tolerances shall be as shown in Table T.2.1. Tolerances are expressed as a fraction of the percent moisture content of the official grain sample, together with a minimum tolerance.

(Amended 2001)

Table T.2.1. Acceptance and Maintenance Tolerances Air Oven Reference Method		
Type of Grain, Class, or Seed	Tolerance	Minimum Tolerance
Corn, oats, rice, Sorghum, sunflower	0.05 of the percent moisture content	0.8 percent in moisture content
All other cereal grains and oil seeds	0.04 of the percent moisture content	0.7 percent in moisture content

(Amended 2001)

**T.2.2. Meter to Like-Type Meter Method.** - Maintenance and acceptance tolerances shall be as shown in Table T.2.2. The tolerances shall apply to all types of grain and seed.

(Added 2001)

Table T.2.2. Acceptance and Maintenance Tolerances Meter to Like Type Meter Method	
Sample Reference Moisture	Tolerance
Up to 22 percent	0.5 percent in moisture content

(Table Added 2001)



**T.3. For Test Weight Per Bushel Indications or Recorded Representations.** - The maintenance and acceptance tolerances on test weight per bushel indications or recorded representations shall be as shown in Table T.3. Tolerances are (+) positive or (-) negative with respect to the value assigned to the official grain sample.  
(Amended 1992 and 2003)

<b>Table T.3. Acceptance and Maintenance Tolerances Test Weight Per Bushel</b>	
Type of Grain or Seed	Tolerance (Pounds Per Bushel)
Corn, oats	0.8
All wheat classes	0.5
Soybeans, all barley classes, all rice classes, sunflower, sorghum	0.7

(Added 2003)

## **UR. User Requirements**

### **UR.1. Selection Requirements.**

**UR.1.1. Value of the Smallest Unit on Primary Indicating and Recording Elements.** - The resolution of the moisture meter display shall be 0.1% moisture and 0.1 pound per bushel test weight during commercial use.  
(Amended 2003)

**UR.1.2. See G-UR.1.2.**

**UR.2. Installation Requirements.** - The grain moisture meter shall be installed in an environment within the range of temperature and/or other environmental factors specified in the operating instructions.

### **UR.3. Use Requirements.**

**UR.3.1. Operating Instructions.** - The operating instructions for the use of the grain moisture meter shall be readily available to the user, service technician, and weights and measures official at the place of installation. It shall include a list of accessory equipment and the kinds of grain or seed to be measured with the moisture meter.  
(Amended 1988)

**UR.3.2. Other Devices Not Used for Commercial Measurement.** - If there are other moisture meters on the premises not used for trade or determining other charges for services, these devices shall be clearly and conspicuously marked "Not for Use in Trade or Commerce."

**UR.3.3. Maintaining Integrity of Grain Samples.** - Whenever there is a time lapse (temperature change) between taking the sample and testing the sample, means to prevent condensation of moisture or loss of moisture from grain samples shall be used. For example, a cold grain sample may be kept in a closed container in order to permit the cold grain to come to the operating temperature range of the meter before the grain moisture measurements are made.

### **UR.3.4. Printed Tickets.**

- (a) Printed tickets shall be free from any previous indication of moisture content or type of grain or seed selected.
- (b) The customer shall be given a printed ticket showing the date, grain type, grain moisture results, test weight per bushel, and calibration version identification. The ticket shall be generated by the grain moisture meter system.  
(Amended 1993, 1995 and 2003)

**UR.3.5. Accessory Devices.** - Accessory devices, if necessary in the determination of a moisture content value, shall be in close proximity to the moisture meter and allow immediate use.

**UR.3.6. Sampling.** - A grain sample shall be obtained by following appropriate sampling methods and equipment. These include, but are not limited to grain probes of appropriate length used at random locations in the bulk, the use of a pelican sampler, or other techniques and equipment giving equivalent results. The grain sample shall be taken such that it is representative of the lot.

**UR.3.7. Location.** - See G-UR.3.3.

**UR.3.8. Level Condition.** - If equipped with a level indicator, a meter shall be maintained in a level condition.  
(Added 1988)

**UR.3.9. Current Calibration Data.** - Grain moisture determinations shall be made using only the most recently published calibration data.

**UR.3.10. Posting of Meter Operating Range.** - The operating range of the grain moisture meter shall be clearly and conspicuously posted in the place of business such that the information is readily visible from a reasonable customer position. The posted information shall include the following:

## 5.56.(a) Grain Moisture Meters

- (a) The temperature range over which the meter may be used and still comply with the applicable requirements. If the temperature range varies for different grains or seed, the range shall be specified for each.
- (b) The moisture range for each grain or seed for which the meter is to be used.
- (c) The temperature range for each grain or seed for which the meter is to be used.
- (d) The maximum allowable difference in temperature that may exist between the meter and the sample for which an accurate moisture determination can be made.  
(Added 1988)

<b>Table S.1.2. Grain Types Considered for Type Evaluation and Calibration and Minimum Acceptable Abbreviations</b>			
<b>Grain Type</b>	<b>Minimum Acceptable Abbreviation</b>	<b>Grain Type</b>	<b>Minimum Acceptable Abbreviation</b>
<i>Corn</i>	<i>CORN</i>	<i>Soybeans</i>	<i>SOYB</i>
<i>Durum Wheat</i> <i>Soft White Wheat</i> <i>Hard Red Spring Wheat</i> <i>Hard Red Winter Wheat</i> <i>Soft Red Winter Wheat</i> <i>Hard White Wheat</i>	<i>DURW</i> <i>SWW</i> <i>HRSW</i> <i>HRWW</i> <i>SRWW</i> <i>HDWW</i>	<i>Two-rowed Barley</i> <i>Six-rowed Barley</i> <i>Oats</i>	<i>TRB</i> <i>SRB</i> <i>OATS</i>
<i>Sunflower Seed (Oil)</i>	<i>SUNF</i>	<i>Long Grain Rough Rice</i> <i>Medium Grain Rough Rice</i>	<i>LGRR</i> <i>MGRR</i>
<i>Grain Sorghum</i>	<i>SORG or</i> <i>MILO</i>	<i>Small Oil Seeds (under consideration)</i>	
<i>[Nonretroactive as of January 1, 1998] (Table Added 1993) (Amended 1995, 1998)</i>			

## Definitions

The specific code to which the definition applies is shown in [brackets] at the end of the definition. Definitions for the General Code [1.10] apply to all codes in Handbook 44.

### A

**absolute value.** The absolute value of a number is the magnitude of that number without considering the positive or negative sign. [2.20]

**acceptance test.** The first official test of a farm milk tank, at a particular location, in which the tank is accepted as correct. This test applies to newly constructed tanks, relocated used tanks, and recalibrated tanks. [4.43]

**accurate.** A piece of equipment is “accurate” when its performance or value—that is, its indications, its deliveries, its recorded representations, or its capacity or actual value, etc., as determined by tests made with suitable standards—conforms to the standard within the applicable tolerances and other performance requirements. Equipment that fails so to conform is “inaccurate.” (Also see “correct.”) [1.10]

**all-class.** A description of a multi-class calibration that includes all the classes of a grain type. [5.56(a), 5.57] (Added 2007)

**analog type.** A system of indication or recording in which values are presented as a series of graduations in combination with an indicator, or in which the most sensitive element of an indicating system moves continuously during the operation of the device. [1.10]

**animal scale.** A scale designed for weighing single heads of livestock. [2.20] (Amended 1987)

**apparent mass versus 8.0 g/cm<sup>3</sup>.** The apparent mass of an object versus 8.0 g/cm<sup>3</sup> is the mass of material of density 8.0 g/cm<sup>3</sup> that produces exactly the same balance reading as the object when the comparison is made in air with a density of 1.2 mg/cm<sup>3</sup> at 20 °C. [3.30, 3.32]

**approval seal.** A label, tag, stamped or etched impression, or the like, indicating official approval of a device. (Also see “security seal.”) [1.10]

**atmospheric pressure.** The average atmospheric pressure agreed to exist at the meter at various ranges of elevation, irrespective of variations in atmospheric pressure from time to time. [3.33]

**audit trail.** An electronic count and/or information record of the changes to the values of the calibration or configuration parameters of a device. [1.10, 2.20, 3.30] (Added 1993)

**automatic bulk weighing system.** A weighing system adapted to the automatic weighing of bulk commodities in successive drafts of predetermined amounts, automatically recording the no-load and loaded weight values and accumulating the net weight of each draft. [2.22]

**automatic checkweigher.** An automatic weighing system that does not require the intervention of an operator during the weighing process and used to subdivide items of different weights into one or more subgroups, such as identifying packages that have acceptable or unacceptable fill levels according to the value of the difference between their weight and a pre-determined set point. These systems may be used to fill standard packages for compliance with net weight requirements. [2.24] (Added 2004)

**automatic gravimetric filling machine (instrument).** A filling machine or instrument that fills containers or packages with predetermined and virtually constant mass of product from bulk by automatic weighing, and which comprises essentially an automatic feeding device or devices associated with one or more weighing unit and the appropriate discharge devices. [2.24] (Added 2004)

**automatic hopper scale.** One adapted to the automatic weighing of bulk commodity in successive drafts of predetermined amounts. (This is not an “automatic-indicating scale” defined below.) [2.20]

**automatic-indicating scale.** One on which the weights of applied loads of various magnitudes are automatically indicated throughout all or a portion of the weighing range of the scale. (A scale that automatically weighs out commodity in predetermined drafts, such as an automatic hopper scale, a packaging scale, and the like, is not an “automatic-indicating scale.”) [2.20]

**automatic temperature or density compensation.** The use of integrated or ancillary equipment to obtain from the output of a volumetric meter an equivalent mass, or an equivalent liquid volume at a normal temperature of 70 °F and absolute pressure of 14.696 lb/in<sup>2</sup> absolute. [3.34]

## Definitions

**automatic weighing system (AWS).** An automatic weighing system is a weighing device that, in combination with other hardware and/or software components, automatically weighs discrete items and that does not require the intervention of an operator during the weighing process. Examples include, but are not limited to, weigh-labelers and checkweighers. [2.24]  
(Added 2004)

**automatic zero-tracking mechanism (zero-tracking mechanism).** See “automatic zero-tracking mechanism” under “zero-tracking mechanism.” [2.20, 2.22, 2.24]

**automatic zero-setting mechanism (belt-conveyor scale).** A zero setting device that operates automatically without intervention of the operator after the belt has been running empty. [2.21]  
(Added 2002)

**auxiliary indicator.** Any indicator other than the master weight totalizer that indicates the weight of material determined by the scale. [2.21]

**axle-load scale.** A scale permanently installed in a fixed location, having a load-receiving element specially adapted to determine the combined load of all wheels (1) on a single axle or (2) on a tandem axle of a highway vehicle. [2.20]

## B

**badge.** A metal plate affixed to the meter by the manufacturer showing the manufacturer’s name, serial number and model number of the meter, and its rated capacity. [3.33]

**balance, zero-load.** See “zero-load balance.” [2.20]

**balance indicator.** A combination of elements, one or both of which will oscillate with respect to the other, for indicating the balance condition of a nonautomatic indicating scale. The combination may consist of two indicating edges, lines, or points, or a single edge, line, or point and a graduated scale. [2.20]

**balancing mechanism.** A mechanism (including a balance ball) that is designed for adjusting a scale to an accurate zero-load balance condition. [2.20]

**base pressure.** The absolute pressure used in defining the gas measurement unit to be used, and is the gauge pressure at the meter plus an agreed atmospheric pressure. [3.33]

**basic time rate.** The charge for time for all intervals except the initial interval. [5.54]

**basic tolerances.** Basic tolerances are those tolerances on underregistration and on overregistration, or in excess and in deficiency, that are established by a particular code for a particular device under all normal tests, whether maintenance or acceptance. Basic tolerances include minimum tolerance values when these are specified. Special tolerances, identified as such and pertaining to special tests, are not basic tolerances. [1.10]

**basic distance rate.** The charge for distance for all intervals except the initial interval. [5.54]

**batching meter.** A device used for the purpose of measuring quantities of water to be used in a batching operation. [3.36]

**beam scale.** One on which the weights of loads of various magnitudes are indicated solely by means of one or more weighbeam bars either alone or in combination with counterpoise weights. [2.20]

**beam.** See “weighbeam.” [2.20]

**bell prover.** A calibrated cylindrical metal tank of the annular type with a scale thereon that, in the downward travel in a surrounding tank containing a sealing medium, displaces air through the meter being proved or calibrated. [3.33]

**belt-conveyor.** An endless moving belt for transporting material from place to place. [2.21]

**belt-conveyor scale.** A device that employs a weighing element in contact with a belt to sense the weight of the material being conveyed and the speed (travel) of the material, and integrates these values to produce total delivered weight. [2.21]

**belt-conveyor scale systems area.** The scale area refers to the scale suspension, weigh idlers attached to the scale suspension, 5 approach (-) idlers, and 5 retreat (+) idlers. [2.21]  
(Added 2001)

**billed weight.** The weight used in the computation of the freight, postal, or storage charge, whether actual weight or dimensional weight. [5.58]  
(Added 2004)

**binary submultiples.** Fractional parts obtained by successively dividing by the number 2. Thus, one-half, one fourth, one-eighth, one-sixteenth, and so on, are binary submultiples. [1.10]

**built-for-purpose device.** Any main device or element which was manufactured with the intent that it be used as, or part of, a weighing or measuring device or system. [1.10]  
(Added 2003)

## C

**calibration parameter.** Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy, e.g., span adjustments, linearization factors, and coarse zero adjustments. [2.20, 3.30]

(Added 1993)

**car-wash timer.** A timer used in conjunction with a coin-operated device to measure the time during which car-wash water, cleaning solutions, or waxing solutions are dispensed. [5.55]

**center-reading tank.** One so designed that the gauge rod or surface gauge, when properly positioned for use, will be approximately in the vertical axis of the tank, centrally positioned with respect to the tank walls. [4.43]

**cereal grain and oil seeds.** Agricultural commodities including, but not limited to, corn, wheat, oats, barley, flax, rice, sorghum, soybeans, peanuts, dry beans, safflower, sunflower, fescue seed, etc. [5.56]

**chart recorder.** See analog or digital recorder. (Amended 2002)

**check rate.** A rate of flow usually 20 percent of the capacity rate. [3.33]

**checkweighing scale.** One used to verify predetermined weight within prescribed limits. [2.20]

**class of grain.** Hard Red Winter Wheat as distinguished from Hard Red Spring Wheat as distinguished from Soft Red Winter Wheat, etc. [5.56]

**clear interval between graduations.** The distance between adjacent edges of successive graduations in a series of graduations. If the graduations are “staggered,” the interval shall be measured, if necessary, between a graduation and an extension of the adjacent graduation. (Also see “minimum clear interval.”) [1.10]

**cleared.** A taximeter is “cleared” when it is inoperative with respect to all fare indication, when no indication of fare or extras is shown and when all parts are in those positions in which they are designed to be when the vehicle on which the taximeter is installed is not engaged by a passenger. [5.54]

**cold-tire pressure.** The pressure in a tire at ambient temperature. [5.53, 5.54]

**computing type or computing type device.** A device designed to indicate, in addition to weight or measure, the total money value of product weighed or measured, for one of a series of unit prices. [1.10]

**computing scale.** One that indicates the money values of amounts of commodity weighed, at predetermined unit prices, throughout all or part of the weighing range of the scale. [2.20]

**concave curve.** A change in the angle of inclination of a belt conveyor where the center of the curve is above the conveyor. [2.21]

**concentrated load capacity (CLC) (also referred to as Dual Tandem Axle Capacity (DTAC)).** A capacity rating of a vehicle or axle-load scale, specified by the manufacturer, defining the maximum load applied by a group to two axles with a centerline spaced 4 feet apart and an axle width of 8 feet for which the weighbridge is designed. The concentrated load capacity rating is for both test and use. [2.20] (Added 1988) (Amended 1991, 1994 and 2003)

**configuration parameter.** Any adjustable or selectable parameter for a device feature that can affect the accuracy of a transaction or can significantly increase the potential for fraudulent use of the device and, due to its nature, needs to be updated only during device installation or upon replacement of a component, e.g., division value (increment), sensor range, and units of measurement. [2.20, 3.30] (Added 1993)

**consecutive-car test train.** A train consisting of cars weighed on a reference scale, then coupled consecutively and run over the coupled-in-motion railway track scale under test. [2.20] (Added 1990)

**construction-material hopper scale.** A scale adapted to weighing construction materials such as sand, gravel, cement, and hot oil. [2.20]

**contract sale.** A sale where a written agreement exists, prior to the point of sale, in which both buyer and seller have accepted pricing conditions of the sale. Examples include, but are not limited to: e-commerce, club sales, or pre-purchase agreements. Any devices used in the determination of quantity must comply with NIST Handbook 44. [3.30, 3.31, 3.37] (Added 1993) (Amended 2002)

**conventional scale.** If the use of conversion tables is necessary to obtain a moisture content value, the moisture meter indicating scale is called “conventional scale.” The values indicated by the scale are dimensionless. [5.56]

**conversion table.** Any table, graph, slide rule, or other external device used to determine the moisture content from the value indicated by the moisture meter. [5.56]

**correction table.** Any table, graph, slide rule, or other external device used to determine the moisture content from the value indicated by the moisture meter when the indicated value is altered by a parameter not automatically corrected for in the moisture meter (for example, temperature or test weight). [5.56]

## Definitions

**convex curve.** A change in the angle of inclination of a belt conveyor where the center of the curve is below the conveyor. [2.21]

**conveyor stringers.** Support members for the conveyor on which the scale and idlers are mounted. [2.21]

**correct.** A piece of equipment is “correct” when, in addition to being accurate, it meets all applicable specification requirements. Equipment that fails to meet any of the requirements for correct equipment is “incorrect.” (Also see “accurate.”) [1.10]

**counterbalance weight.** One intended for application near the butt of a weighbeam for zero-load balancing purposes. [2.20]

**counterpoise weight.** A slotted or “hanger” weight intended for application near the tip of the weighbeam of a scale having a multiple greater than 1. [2.20]

**coupled-in-motion railroad weighing system.** A device and related installation characteristics consisting of (1) the associated approach trackage, (2) the scale (i.e., the weighing element, the load-receiving element, and the indicating element with its software), and (3) the exit trackage which permit the weighing of railroad cars coupled in motion. [2.20] (Added 1992)

**crane scale.** One with a nominal capacity of 5000 pounds or more designed to weigh loads while they are suspended freely from an overhead, trackmounted crane. [2.20]

**cryogenic liquid-measuring device.** A system including a liquid-measuring element designed to measure and deliver cryogenic liquids in the liquid state. [3.34] (Amended 1986 and 2003)

**cryogenic liquids.** Fluids whose normal boiling point is below 120 kelvin (-243 °F). [3.34]

**cubic foot, standard.** That quantity of gas that occupies a volume of one cubic foot when under a pressure of 14.73 lb/in<sup>2</sup> absolute and at a temperature of 60 °F. [3.33]

**cubic foot, metered.** That quantity of gas that occupies one cubic foot when under pressure and temperature conditions existing in the meter. [3.33]

**cubic-foot bottle.** A metal bottle open at the lower end and so supported that it may be easily raised or lowered in a tank that contains a sealing medium. With the level of the sealing medium properly adjusted, the bottle, when lowered, will displace exactly one cubic foot of air upon coming to rest on the bottom of the tank. The marks on the bottle defining the cubic foot are the bottom of the lower neck and the gauge mark that partially surrounds the gauge glass in the upper neck. [3.33]

**cubic foot, gas.** The amount of a cryogenic liquid in the gaseous state at a temperature of 70 °F and under a pressure of 14.696 lb/in<sup>2</sup> absolute that occupies one cubic foot. (See NTP.) [3.34]

## D

**“d”, dimension division value.** The smallest increment that the device displays for any axis and length of object in that axis. [5.58] (Added 2004)

**D<sub>max</sub> (maximum load of the measuring range).** Largest value of a quantity (mass) which is applied to a load cell during test or use. This value shall not be greater than E<sub>max</sub>. [2.20] (Added 2005)

**D<sub>min</sub> (minimum load of the measuring range).** Smallest value of a quantity (mass) which is applied to a load cell during test or use. This value shall not be less than E<sub>min</sub>. [2.20] (Added 2006)

**dairy-product-test scale.** A scale used in determining the moisture content of butter and/or cheese or in determining the butterfat content of milk, cream, or butter. [2.20]

**decimal submultiples.** Parts obtained by successively dividing by the number 10. Thus 0.1, 0.01, 0.001, and so on are decimal submultiples. [1.10] (Added 2006)

**decreasing-load test.** A test for automatic-indicating scales only, wherein the performance of the scale is tested as the load is reduced. [2.20] (Amended 1987)

**deficiency.** See “excess and deficiency.” [1.10]

**digital type.** A system of indication or recording of the selector type or one that advances intermittently in which all values are presented digitally, or in numbers. In a digital indicating or recording element, or in digital representation, there are no graduations. [1.10]

**dimensional weight (or dim, weight).** A value computed by dividing the object’s volume by a conversion factor; it may be used for the calculation of charges when the value is greater than the actual weight. [5.58] (Added 2004)

**direct sale.** A sale in which both parties in the transaction are present when the quantity is being determined. An unattended automated or customer-operated weighing or measuring system is considered to represent the device/business owner in transactions involving an unattended device. [1.10] (Amended 1993)

**discharge line.** A rigid pipe connected to the outlet of a measuring device. [3.30] (Added 1987)

**discharge hose.** A flexible hose connected to the discharge outlet of a measuring device or its discharge line. [3.30]  
(Added 1987)

**discrimination (of an automatic-indicating scale).** The value of the test load on the load-receiving element of the scale that will produce a specified minimum change of the indicated or recorded value on the scale. [2.20]

**dispenser.** See motor-fuel device. [3.30]

**distributed-car test train.** A train consisting of cars weighed first on a reference scale, cars coupled consecutively in groups at different locations within the train, then run over the coupled-in-motion railway track scale under test. The groups are typically placed at the front, middle, and rear of the train. [2.20]  
(Added 1990)

**dry-hose type.** A type of device in which it is intended that the discharge hose be completely drained following the mechanical operations involved in each delivery. (See “dry hose.”) [3.30, 3.34]

**dry hose.** A discharge hose intended to be completely drained at the end of each delivery of product. (See “dry-hose type.”) [3.30, 3.31]  
(Amended 2002)

**dynamic monorail weighing system.** A weighing system which employs hardware or software to compensate for dynamic effects from the load or the system that do not exist in a static weighing, in order to provide a stable indication. Dynamic factors may include shock or impact loading, system vibrations, oscillations, etc., and can occur even when the load is not moving across the load receiving element. [2.20]  
(Added 1999)

## E

**$E_{\max}$  (maximum capacity).** Largest value of a quantity (mass) which may be applied to a load cell without exceeding the mpe. [2.20]  
(Added 2005)

**$e_{\min}$  (minimum verification scale division).** The smallest scale division for which a weighing element complies with the applicable requirements. [2.20, 2.21, 2.24]  
(Added 1997)

**$E_{\min}$  (minimum dead load).** Smallest value of a quantity (mass) which may be applied to a load cell during test or use without exceeding the mpe. [2.20]  
(Added 2006)

**electronic link.** An electronic connection between the weighing/load receiving or other sensing element and indicating element where one recognizes the other and neither can be replaced without calibration. [2.20]  
(Added 2001)

**element.** A portion of a weighing or measuring device or system which performs a specific function and can be separated, evaluated separately, and is subject to specified full or partial error limits.  
(Added 2002)

**equal-arm scale.** A scale having only a single lever with equal arms (that is, with a multiple of 1), equipped with two similar or dissimilar load-receiving elements (pan, plate, platter, scoop, or the like), one intended to receive material being weighed and the other intended to receive weights. There may or may not be a weighbeam. [2.20]

**event counter.** A nonresettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to sealable calibration or configuration parameters of a device. [2.20, 3.30]  
(Added 1993)

**event logger.** A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter. [2.20, 3.30]  
(Added 1993)

**excess and deficiency.** When an instrument or device is of such a character that it has a value of its own that can be determined, its error is said to be “in excess” or “in deficiency,” depending upon whether its actual value is, respectively, greater or less than its nominal value. (See “nominal.”) Examples of instruments having errors “in excess” are: a linear measure that is too long; a liquid measure that is too large; and a weight that is “heavy.” Examples of instruments having errors “in deficiency” are: a lubricating-oil bottle that is too small; a vehicle tank compartment that is too small; and a weight that is “light.” [1.10]

**extras.** Charges to be paid by a passenger in addition to the fare, including any charge at a flat rate for the transportation of passengers in excess of a stated number and any charge for the transportation of baggage. [5.54]

## F

**face.** That side of a taximeter on which passenger charges are indicated. [5.54]

**face.** That portion of a computing-type pump or dispenser which the actual computation of price per unit, delivered quantity, and total sale price. In the case of some electronic displays, this may not be an integral part of the pump or dispenser. [3.30]  
(Added 1987)

## Definitions

**fare.** That portion of the charge for the hire of a vehicle that is automatically calculated by a taximeter through the operation of the distance and/or time mechanism. [5.54]

**farm milk tank.** A unit for measuring milk or other fluid dairy product, comprising a combination of (1) a stationary or portable tank, whether or not equipped with means for cooling its contents, (2) means for reading the level of liquid in the tank, such as a removable gauge rod or a surface gauge, and (3) a chart for converting level-of-liquid readings to volume; or such a unit in which readings are made on gauge rod or surface gauge directly in terms of volume. Each compartment of a subdivided tank shall, for purposes of this code, be construed to be a “farm milk tank.” [4.43]

**feeding mechanism.** The means for depositing material to be weighed on the belt conveyor. [2.21]

**fifth wheel.** A commercially-available distance-measuring device which, after calibration, is recommended for use as a field transfer standard for testing the accuracy of taximeters and odometers on rented vehicles. [5.53, 5.54]

**fifth-wheel test.** A distance test similar to a road test, except that the distance traveled by the vehicle under test is determined by a mechanism known as a “fifth-wheel” that is attached to the vehicle and that independently measures and indicates the distance. [5.53, 5.54]

**flag.** A plate at the end of the lever arm or similar part by which the operating condition of a taximeter is controlled and indicated. [5.54]

**fractional bar.** A weighbeam bar of relatively small capacity for obtaining indications intermediate between notches or graduations on a main or tare bar. [2.20]

**ft<sup>3</sup>/h.** Cubic feet per hour. [3.33]

## G

**gasoline gallon equivalent (GGE).** Gasoline gallon equivalent (GGE) means 5.660 pounds of natural gas. [3.37] (Added 1994)

**gasoline liter equivalent (GLE).** Gasoline liter equivalent (GLE) means 0.678 kilograms of natural gas. [3.37] (Added 1994)

**gauge pressure.** The difference between the pressure at the meter and the atmospheric pressure (psi). [3.33]

**gauge rod.** A graduated, “dip-stick” type of measuring rod designed to be partially immersed in the liquid and to be read at the point where the liquid surface crosses the rod. [4.43]

**gauging.** The process of determining and assigning volumetric values to specific graduations on the gauge or gauge rod that serve as the basis for the tank volume chart. [4.43]

**graduated interval.** The distance from the center of one graduation to the center of the next graduation in a series of graduations. (Also see “value of minimum graduated interval.”) [1.10]

**graduation.** A defining line, or one of the lines defining the subdivisions of a graduated series. The term includes such special forms as raised or indented or scored reference “lines” and special characters such as dots. (Also see “main graduation” and “subordinate graduation.”) [1.10]

**grain class.** Different grains within the same grain type. For example, there are six classes for the grain type “wheat:” Durum Wheat, Hard Red Spring Wheat, Hard Red Winter Wheat, Soft Red Winter Wheat, Hard White Wheat, and Soft White Wheat. [5.56(a), 5.57] (Added 2007)

**grain hopper scale.** One adapted to the weighing of individual loads of varying amounts of grain. [2.20]

**grain moisture meter.** Any device indicating either directly or through conversion tables and/or correction tables the moisture content of cereal grains and oil seeds. Also termed “moisture meter.” [5.56]

**grain sample.** That portion of grain or seed taken from a bulk of grain or seed to be bought or sold and used to determine the moisture content of the bulk. [5.56]

**grain-test scale.** A scale adapted to weighing grain samples used in determining moisture content, dockage, weight per unit volume, etc. [2.20, 5.56]

**grain type.** See “kind of grain.” [5.56(a), 5.57] (Added 2007)

**gravity discharge.** A type of device designed for discharge by gravity. [3.30, 3.31] (Amended 2002)

## H

**head pulley.** The pulley at the discharge end of the belt conveyor. The power drive to drive the belt is generally applied to the head pulley. [2.21]

**hired.** A taximeter is “hired” when it is operative with respect to all applicable indications of fare or extras. The indications of fare include time and distance where applicable unless qualified by another indication of “Time Not Recording” or an equivalent expression. [5.54]

**hopper scale.** A scale designed for weighing bulk commodities whose load-receiving element is a tank, box, or hopper mounted on a weighing element. (Also, see “automatic hopper scale,” “grain hopper scale,” and “construction-material hopper scale.”) [2.20]



## I

**idler space.** The center-to-center distance between idler rollers measured parallel to the belt. [2.21]

**idlers or idler rollers.** Freely turning cylinders mounted on a frame to support the conveyor belt. For a flat belt, the idlers consist of one or more horizontal cylinders transverse to the direction of belt travel. For a troughed belt, the idlers consist of one or more horizontal cylinders and one or more cylinders at an angle to the horizontal to lift the sides of the belt to form a trough. [2.21]

**in-service light indicator.** A light used to indicate that a timing device is in operation. [5.55]

**increasing-load test.** The normal basic performance test for a scale in which observations are made as increments of test load are successively added to the load-receiving element of the scale. [2.20]

**increment.** The value of the smallest change in value that can be indicated or recorded by a digital device in normal operation. [1.10]

**index of an indicator.** The particular portion of an indicator that is directly utilized in making a reading. [1.10]

**indicating element.** An element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is “read” from the device itself as, for example, an index-and-graduated-scale combination, a weighbeam-and-poise combination, a digital indicator, and the like. (Also see “primary indicating or recording element.”) [1.10]

**indicator, balance.** See “balance indicator.” [2.20]

**initial zero-setting mechanism.** Automatic means provided to set the indication to zero at the time the instrument is switched on and before it is ready for use. [2.20]  
(Added 1990)

**initial distance or time interval.** The interval corresponding to the initial money drop. [5.54]

**interval, graduated.** See “graduated interval.” [1.10]

**interval, clear, between graduations.** See “clear interval between graduations.” [1.10]

## J

**jewelers' scale.** One adapted to weighing gems and precious metals. [2.20]

## K

**kind of grain.** Corn as distinguished from soybeans as distinguished from wheat, etc. [5.56]

## L

**label.** A printed ticket, to be attached to a package, produced by a printer that is a part of a prepackaging scale or that is an auxiliary device. [2.20]

**large-delivery device.** Devices used primarily for single deliveries greater than 200 gallons, 2000 pounds, 20 000 cubic feet, 2 000 liters, or 2 000 kilograms. [3.34]

**laundry-drier timer.** A timer used in conjunction with a coin-operated device to measure the period of time that a laundry drier is in operation. [5.55]

**liquefied petroleum gas vapor-measuring device.** A system including a mechanism or device of the meter type, equipped with a totalizing index, designed to measure and deliver liquefied petroleum gas in the vapor state by definite volumes, and generally installed in a permanent location. The meters are similar in construction and operation to the conventional natural- and manufactured-gas meters. [3.32]

**liquefied petroleum gas.** A petroleum product composed predominantly of any of the following hydrocarbons or mixtures thereof: propane, propylene, butanes (normal butane or isobutane), and butylenes. [3.32, 3.33]

**liquefied petroleum gas liquid-measuring device.** A system including a mechanism or machine of the meter type designed to measure and deliver liquefied petroleum gas in the liquid state by a definite quantity, whether installed in a permanent location or mounted on a vehicle. Means may or may not be provided to indicate automatically, for one of a series of unit prices, the total money value of the liquid measured. [3.33]  
(Amended 1987)

**liquid volume correction factor.** A correction factor used to adjust the liquid volume of a cryogenic product at the time of measurement to the liquid volume at NBP. [3.34]

**liquid-fuel device.** A device designed for the measurement and delivery of liquid fuels. [3.30]

**liquid-measuring device.** A mechanism or machine designed to measure and deliver liquid by definite volume. Means may or may not be provided to indicate automatically, for one of a series of unit prices, the total money value of the liquid measured, or to make deliveries corresponding to specific money values at a definite unit price. [3.30]

**liquid fuel.** Any liquid used for fuel purposes, that is, as a fuel, including motor fuel. [3.30]

## Definitions

**livestock scale.** A scale equipped with stock racks and gates and adapted to weighing livestock standing on the scale platform. [2.20]  
(Amended 1989)

**load-receiving element.** That element of a scale that is designed to receive the load to be weighed; for example, platform, deck, rail, hopper, platter, plate, scoop. [2.20]

**load cell.** A device, whether electric, hydraulic, or pneumatic, that produces a signal proportional to the load applied. [2.20]

**load cell verification interval (v).** The load cell interval, expressed in units of mass, used in the test of the load cell for accuracy classification. [2.20, 2.21]  
(Added 1996)

**loading point.** The location at which material to be conveyed is applied to the conveyor. [2.21]

**low-flame test.** A test simulating extremely low-flow rates such as caused by pilot lights. [3.33]

**lubricant device.** A device designed for the measurement and delivery of liquid lubricants, including, but not limited to, heavy gear lubricants and automatic transmission fluids (automotive). [3.30]

## M

**m<sup>3</sup>/h.** Cubic meters per hour. [3.33]

**main-weighbeam elements.** The combination of a main bar and its fractional bar, or a main bar alone if no fractional bar is associated with it. [2.20]

**main bar.** A principal weighbeam bar, usually of relatively large capacity as compared with other bars of the same weighbeam. (On an automatic-indicating scale equipped with a weighbeam, the main weighbeam bar is frequently called the “capacity bar.”) [2.20]

**main graduation.** A graduation defining the primary or principal subdivisions of a graduated series. (Also see “graduation.”) [1.10]

**manual zero-setting mechanism.** Nonautomatic means provided to attain a zero balance indication by the direct operation of a control. [2.20]

**manufactured device.** Any commercial weighing or measuring device shipped as new from the original equipment manufacturer. [1.10]  
(Amended 2001)

**mass flow meter.** A device that measures the mass of a product flowing through the system. The mass measurement may be determined directly from the effects of mass on the sensing unit or may be inferred by measuring the properties of

the product, such as the volume, density, temperature, or pressure, and displaying the quantity in mass units. [3.30, 3.32]

**master meter test method.** A method of testing milk tanks that utilizes an approved master meter system for measuring test liquid removed from or introduced into the tank. [4.43]

**master weight totalizer.** An indicating element used with a belt conveyor scale to indicate the weight of material that was passed over the scale. The master weight totalizer is a primary indicating element of the belt-conveyor scale. [2.21]

**material test.** The test of a belt-conveyor scale using material (preferably that for which the device is normally used) that has been weighed to an accuracy of 0.1 percent. [2.21]  
(Amended 1989)

**maximum capacity.** The largest load that may be accurately weighed. [2.24]  
(Added 1999)

**maximum cargo load.** The maximum cargo load for trucks is the difference between the manufacturer's rated gross vehicle weight and the actual weight of the vehicle having no cargo load. [5.53]

**measuring element.** That portion of a complete multiple dimension measuring device that does not include the indicating element. [5.58]  
(Added 2004)

**measurement field.** A region of space or the measurement pattern produced by the measuring instrument in which objects are placed or passed through, either singly or in groups, when being measured by a single device. [5.58]  
(Added 2004)

**meter register.** An observation index for the cumulative reading of the gas flow through the meter. In addition there are one or two proving circles in which one revolution of the test hand represents 1/2, 1, 2, 5, or 10 cubic feet, or 0.025, 0.05, 0.1, 0.2, or 0.25 cubic meter, depending on meter size. If two proving circles are present, the circle representing the smallest volume per revolution is referred to as the “leak-test circle.” [3.33]

**metrological integrity (of a device).** The design, features, operation, installation, or use of a device that facilitates (1) the accuracy and validity of a measurement or transaction, (2) compliance of the device with weights and measures requirements, or (3) the suitability of the device for a given application. [1.10, 2.20]  
(Added 1993)

**minimum capacity.** The smallest load that may be accurately weighed. The weighing results may be subject to excessive error if used below this value. [2.24]  
(Added 1999)

**minimum totaled load.** The least amount of weight for which the scale is considered to be performing accurately. [2.21]

**minimum tolerances.** Minimum tolerances are the smallest tolerance values that can be applied to a scale. Minimum tolerances are determined on the basis of the value of the minimum graduated interval or the nominal or reading face capacity of the scale. (See also definition for basic tolerances.) [2.20]

**minimum clear interval.** The shortest distance between adjacent graduations when the graduations are not parallel. (Also see “clear interval.”) [3.30]

**minimum delivery.** The least amount of weight that is to be delivered as a single weighment by a belt-conveyor scale system in normal use. [2.21]

**moisture content (wet basis).** The mass of water in a grain or seed sample (determined by the reference method) divided by the mass of the grain or seed sample expressed as a percentage (%). [5.56]

**money-operated type.** A device designed to be released for service by the insertion of money, or to be actuated by the insertion of money to make deliveries of product. [1.10]

**money drop.** An increment of fare indication. The “initial money drop” is the first increment of fare indication following activation of the taximeter. [5.54]

**motor-fuel device or motor-fuel dispenser or retail motor-fuel device.** A device designed for the measurement and delivery of liquids used as fuel for internal-combustion engines. The term “motor-fuel dispenser” means the same as “motor-fuel device”; the term “retail motor-fuel device” applies to a unique category of device (see definition of “retail device”). [3.30]

**motor fuel.** Liquid used as fuel for internal-combustion engines. [3.30]

**multi-class.** A description of a grouping of grain classes, from the grain type, in one calibration. A multi-class grain calibration may include (1) all the classes of a grain type (all-class calibration), or (2) some of the classes of a grain type within the calibration. [5.56(a), 5.57]  
(Added 2007)

**multi-interval scale.** A scale having one weighing range which is divided into partial weighing ranges (segments), each with different scale intervals, with each partial weighing range (segment) determined automatically according to the load applied, both on increasing and decreasing loads. [2.20]  
(Added 1995) (Amended 2005 and 2006)

**multi-jet water meter.** A water meter in which the moving element takes the form of a multiblade rotor mounted on a vertical spindle within a cylindrical measuring chamber. The

liquid enters the measuring chamber through several tangential orifices around the circumference and leaves the measuring chamber through another set of tangential orifices placed at a different level in the measuring chamber. These meters register by recording the revolutions of a rotor set in motion by the force of flowing water striking the blades. [3.36]

(Added 2003)

**multi-revolution scale.** An automatic-indicating scale having a nominal capacity that is a multiple of the reading-face capacity and that is achieved by more than one complete revolution of the indicator. [2.20]

**multiple cell application load cell.** A load cell intended for use in a weighing system which incorporates more than one load cell. A multiple cell application load cell is designated with the letter “M” or the term “Multiple.” (See also “single cell application load cell.”) [2.20]  
(Added 1999)

**multiple of a scale.** In general, the multiplying power of the entire system of levers or other basic weighing elements. (On a beam scale, the multiple of the scale is the number of pounds on the load-receiving element that will be counterpoised by 1 pound applied to the tip pivot of the weighbeam.) [2.20]

**multiple range scale.** A scale having two or more weighing ranges with different maximum capacities and different scale intervals for the same load receptor, each range extending from zero to its maximum capacity. [2.20]  
(Added 1995)

**multiple-tariff taximeter.** One that may be set to calculate fares at any one of two or more rates. [5.54]

**multiple.** An integral multiple; that is, a result obtained by multiplying by a whole number. (Also see “multiple of a scale.”) [1.10]

## N

**natural gas.** A gaseous fuel, composed primarily of methane, that is suitable for compression and dispensing into a fuel storage container(s) for use as an engine fuel. [3.37]  
(Added 1994)

**NBP.** Normal boiling point of a cryogenic liquid at 14.696 lb/in<sup>2</sup> absolute. [3.34]

**n<sub>max</sub> (maximum number of scale divisions).** The maximum number of scale divisions for which a main element or load cell complies with the applicable requirements. The maximum number of scale divisions permitted for an installation is limited to the lowest n<sub>max</sub> marked on the scale indicating element, weighing element, or load cell. [2.20, 2.21, 2.24]  
(Added 1997)

## Definitions

**no-load reference value.** A positive weight value indication with no load in the load-receiving element (hopper) of the scale. (Used with automatic bulk-weighing systems and certain single draft, manually-operated receiving hopper scales installed below grade and used to receive grain.) [2.20]

**nominal.** Refers to “intended” or “named” or “stated,” as opposed to “actual.” For example, the “nominal” value of something is the value that it is supposed or intended to have, the value that it is claimed or stated to have, or the value by which it is commonly known. Thus, “1-pound weight,” “1-gallon measure,” “1-yard indication,” and “500-pound scale” are statements of nominal values; corresponding actual values may be greater or lesser. (See nominal capacity of a scale.) [1.10]

**nominal capacity.** The nominal capacity of a scale is (a) the largest weight indication that can be obtained by the use of all of the reading or recording elements in combination, including the amount represented by any removable weights furnished or ordinarily furnished with the scale, but excluding the amount represented by any extra removable weights not ordinarily furnished with the scale, and excluding also the capacity of any auxiliary weighing attachment not contemplated by the original design of the scale, and excluding any fractional bar with a capacity less than 2-1/2 percent of the sum of the capacities of the remaining reading elements, or (b) the capacity marked on the scale by the manufacturer, whichever is less. (Also see “nominal capacity, batching scale”; “nominal capacity, hopper scale.”) [2.20]

**nominal capacity, batching scale.** The nominal capacity of a batching scale is the capacity as marked on the scale by the scale manufacturer, or the sum of the products of the volume of each of the individual hoppers, in terms of cubic feet, times the weight per cubic foot of the heaviest material weighed in each hopper, whichever is less. [2.20]

**nominal capacity, hopper scale.** The nominal capacity of a hopper scale is the capacity as marked on the scale by the scale manufacturer, or the product of the volume of the hopper in bushels or cubic feet times the maximum weight per bushel or cubic foot, as the case may be, of the commodity normally weighed, whichever is less. [2.20]

**non-automatic checkweigher.** A weighing instrument that requires the intervention of an operator during the weighing process, used to subdivide items of different weights into one or more subgroups, such as identifying packages that have acceptable or unacceptable fill levels according to the value of the difference between their weight and a pre-determined set point. [2.24]

**Notes:** Determining the weighing result includes any intelligent action of the operator that affects the result, such as deciding and taking an action when an indication is stable or adjusting the weight of the weighed load.

Deciding that the weighing result is acceptable means making a decision regarding the acceptance of each weighing result on observing the indication or releasing a print out. The weighing process allows the operator to take an action which influences the weighing result in the case where the weighing result is not acceptable.

(Added 2004)

**non-automatic weighing instrument.** A weighing instrument or system that requires the intervention of an operator during the weighing process to determine the weighing result or to decide that it is acceptable. [2.20, 2.24]

**Notes:** Determining the weighing result includes any intelligent action of the operator that affects the result, such as deciding and taking an action when an indication is stable or adjusting the weight of the weighed load.

Deciding that the weighing result is acceptable means making a decision regarding the acceptance of each weighing result on observing the indication or releasing a print out. The weighing process allows the operator to take an action which influences the weighing result in the case where the weighing result is not acceptable.

(Added 2004) (Amended 2005)

**nonretroactive.** “Nonretroactive” requirements are enforceable after the effective date for:

1. devices manufactured within a State after the effective date;
2. both new and used devices brought into a State after the effective date; and
3. devices used in noncommercial applications which are placed into commercial use after the effective date.

Nonretroactive requirements are not enforceable with respect to devices that are in commercial service in the State as of the effective date or to new equipment in the stock of a manufacturer or a dealer in the State as of the effective date. (*Nonretroactive requirements are printed in italic type.*) [1.10]

(Amended 1989)

**nose-iron.** A slide-mounted, manually-adjustable pivot assembly for changing the multiple of a lever. [2.20]

**notes.** A section included in each of a number of codes, containing instructions, pertinent directives, and other specific information pertaining to the testing of devices. Notes are primarily directed to weights and measures officials. [1.10]

**NTP density and volume correction factor.** A correction factor used to adjust the liquid volume of a cryogenic product at the time of measurement to the gas equivalent at NTP. [3.34]

**zero-load reference (belt-conveyor scales).** A zero-load reference value represents no load on a moving conveyor belt. This value can be either; a number representing the electronic load cell output, a percentage of full scale capacity, or other reference value that accurately represents the no load condition of a moving conveyor belt. The no load reference value can only be updated after the completion of a zero load test. [2.21] (Added 2002)

**zero-setting mechanism.** Means provided to attain a zero balance indication with no load on the load-receiving element. Three types of these mechanisms are: [2.20]

**automatic zero-tracking mechanism** Automatic means provided to maintain zero balance indication, within certain limits, without the intervention of an operator. [2.20, 2.22, 2.24]

**manual zero-setting mechanism.** Nonautomatic means provided to attain a zero balance indication by the direct operation of a control. [2.20]

**semiautomatic zero-setting mechanism.** Automatic means provided to attain a direct zero balance indication requiring a single initiation by an operator. [2.20]

**zero-setting mechanism (belt-conveyor scale).** A mechanism enabling zero totalization to be obtained over a whole number of belt revolutions. [2.21, 2.23] (Added 2002)

**zero-tracking mechanism.** Automatic means provided to maintain zero balance indication without the intervention of an operator. [2.20] (Added 2005) (Amended 2006)

**zone of uncertainty.** The zone between adjacent increments on a digital device in which the value of either of the adjacent increments may be displayed. [2.20]

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